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In the spring of 1965, West Virginia University called a moratorium on undergraduate enrollment in industrial arts education. This was to provide time for the faculty to review and develop a new approach to this program. An interdisciplinary conference was held in an attempt to meet this goal. It was designed to determine the university's function in industrial arts teacher education and to provide recommendations on program scope, elements, and resource personnel. This tapescript of the 3-day conference includes these presentations: (1) "The University and Industrial Arts Teacher Education" by William J. Micheels, (2) "Considerations for the Future: Technology and Change" by John McHale, and (3) "A Proposed Content Structure" by Thomas J. Brennan and Paul W. DeVore. In addition, verbatim reports are given for general and small group discussions. Some recommendations from the last session were that industrial arts give students the language and some feeling for the modes of association and transaction in industry, and an understanding of their environment. Resource persons were identified and program suggestions were offered throughout the discussions. (EM)

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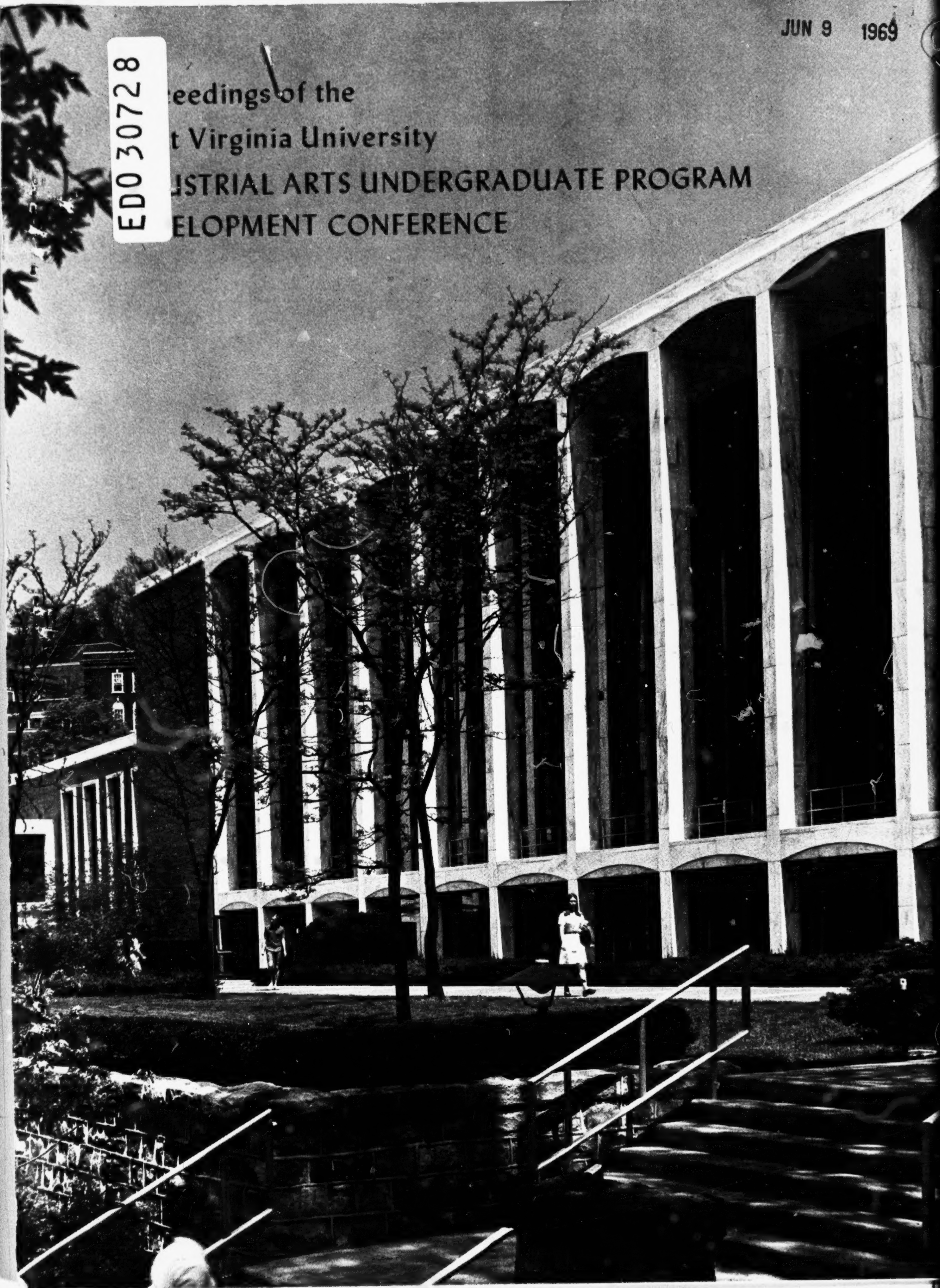

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Proceedings of the West Virginia University Industrial Arts Undergraduate Program Development Conference (Morgantown, November 8-10, 196

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Mont Chateau Conference Center
West Virginia University
Morgantown, West Virginia 26505

November 8, 9, and 10

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West Virginia University Industrial Arts Undergraduate Program Development Conference

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Dr. Kenneth E. Dawson, Dean
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Dr. William D. Drake
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University of Michigan

Dr. William J. Micheels, President
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Dr. Bruce Sinclair
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Dr. John McHale
World Resources Inventory
Southern Illinois University

University Faculty

Dr. Stanley O. Ikenberry, Dean
College of Human Resources and Education

Dr. William Katz, Director
Division of Education

Dr. Thomas J. Brennan, Coordinator
Industrial Arts

Dr. Paul W. DeVore, Professor
Industrial Arts

INDUSTRIAL ARTS UNDERGRADUATE PROGRAM DEVELOPMENT CONFERENCE

In the spring of 1965 The College of Human Resources and Education of West Virginia University called a moratorium on undergraduate enrollment in the industrial arts program. The purpose of the moratorium was to provide an extended period of time for the faculty to engage in a "searching review of its program and to develop a forward looking approach capable of meeting the challenge of the future."

An interdisciplinary conference was planned to facilitate the research and to aid in meeting the goal of the moratorium. The conference was designed to:

(1) Determine the function of a state university in relation to industrial arts teacher education with specific attention to:

  (a) the educational needs of individuals and society in terms of those areas of present or future influence in which the industrial arts could or should contribute.

  (b) identifying the knowledge or content reservoir and structure from which a curriculum capable of meeting the challenge of the future can be derived.

  (c) identifying the characteristics and competencies of the individual who would serve as a teacher and resource person in the society in his area of specialty.

(2) Provide recommendations and suggestions in terms of:

  (a) the scope and delimitation of future research endeavors.
  (b) major elements of the problem.
  (c) methods or procedures for attacking the problem.
  (d) resource personnel capable of contributing to specific areas of the problem.

The transcript of the proceedings which follows provides a record of the efforts of a group of scholars and citizens of diverse backgrounds and experience in attempting to analyze the issues raised in the foregoing statements. That they succeeded as well as they did in the time alloted is a tribute to their intellect and their keen interest in the education of youth.

Paul W. DeVore, Editor

WEST VIRGINIA UNIVERSITY

INDUSTRIAL ARTS UNDERGRADUATE PROGRAM DEVELOPMENT CONFERENCE
AGENDA

Wednesday, November 8, 1967

4:00-6:00 PM	Arrival and Registration
7:00 PM	Dinner
8:00 PM	Conference Orientation Introductions: Dr. Kenneth E. Dawson The Development Project: Dr. T. J. Brennan Background for Discussion: "The University and Industrial Arts Teacher Education." Dr. William J. Micheels

Thursday, November 9, 1967

9:00-9:20 AM	Background for Discussion: "Considerations for the Future-Technology and Change." Professor John McHale
9:30-10:30 AM	Advisory Council Meeting-General Session Chairman: Dr. Kenneth E. Dawson
10:30-10:45 AM	Refreshments
10:45-12:00	Advisory Council Meeting-General Session Chairman: Dr. Kenneth E. Dawson
12:00	Lunch
1:30-3:30 PM	Advisory Council Meeting Section #1 Dr. Micheels Section #2 Dr. Drake
3:30-6:00 PM	Recreation
6:00 PM	Dinner
8:00-8:45 PM	Background for Discussion: "A Proposed Content Structure." Dr. T. J. Brennan and Dr. Paul W. DeVore
8:45-9:30 PM	General Discussion on total problem: Chairman: Dr. Kenneth E. Dawson

Friday, November 10, 1967

8:30-10:30 AM	Advisory Council Meeting: Section #1 Dr. Micheels Section #2 Dr. Drake
10:30-10:45 AM	Refreshments
10:45-12:45	Advisory Council Meeting: General Session Chairman: Dr. Kenneth E. Dawson 1. Section reports and recommendations 2. General discussion and recommendations 3. Conference summation - Dr. Dawson 4. Concluding remarks - Dean Ikenberry
1:00 PM	Lunch and au revoir

INDUSTRIAL ARTS UNDERGRADUATE PROGRAM DEVELOPMENT CONFERENCE
WEST VIRGINIA UNIVERSITY
DIVISION OF EDUCATION
COLLEGE OF HUMAN RESOURCES AND EDUCATION
Morgantown, West Virginia
November 8-10, 1967

Wednesday Evening, November 8, 1967
Dr. Kenneth Dawson, Conference Chairman

DAWSON:

.....This evening, as we gather, we might think of it as being a great historic event. I say this for two reasons: One, because we have come together for the first time to undertake a task which has never been undertaken before. Two, we may come together to sound a deathnell for a program or to send it on its way to becoming a major curriculum area. The fact that West Virginia University has decided to call a moratorium on the industrial arts program for the next several years, in an attempt to determine the content, the domain, and the providence of industrial arts, has a significance which we may not realize initially.

When Paul called me and asked if I could meet with you, I had two feelings. One really was the feeling of fear. This, I think is evident in the fact that what we do here at this conference could set the stage for what industrial arts might be in the future. On the other hand, we could fall flat on our face and not do the things that this University has commissioned us to do. The reason I had such trepidation was that here is a University that was willing to say that it was willing to develop a program in whatever way seemed best through the use of the finest minds in the country with an interdisciplinary approach who can tell us what industrial arts should be and who can help make it exactly what we want. Another reason for my concern was because in my own mind, I am not at all sure what I think industrial arts should be. I have some ideas. I doubt that Dr. DeVore or Dr. Brennan or any of the rest of the people have in their own minds ideas sufficient to build a program they would like to see emanate from the University of West Virginia. In view of the critical nature of our task and the challenges before us, it is a rare privilege for me, as program chairman, to introduce to you the people who have convened here for these two or three days.

We will begin with the list which you have received, which is identified "Conferees". We have one person who will not be able to be with us. He is Dr. Donald Bigelow, Director of Education and Personnel Training at the United States Office of Education. Dr. Bigelow is involved in another urgent assignment.

Tonight, we want to suggest that as you make comments about yourselves, do not be overly modest. I should like for each of us to identify the personal reasons why we think we were chosen for this conference. These people have been invited together because they have great strength in some field which impinges upon industrial arts.

May I introduce first, Dr. William D. Drake of the Institute for Science and Technology, University of Michigan. Dr. Drake, please tell us about your background, which we are sure will bring strength to this conference. Why do you think you are here and in what direction would you like us to focus?

DRAKE: My formal academic training was in systems analysis, operational research and economics. Since that time I have been concerned more and more with ways in which science and technology can be used for solving societal problems as opposed to military and industrial problems. I am currently program chairman of a new interdisciplinary doctoral program in urban and regional planning at the University of Michigan.

DAWSON: Thank you, sir. Dr. William J. Micheels is President of Stout State University in Menomonie, Wisconsin. We look forward to hearing Bud, as we fondly call him, bring a presentation this evening. Bud, if you will, give us something of your background and the reason you feel you were invited to this conference.

MICHEELS: Well, I have been associated with the field of industrial arts education for a number of years but now I may have gone sour, since becoming a President, and I am not quite sure why I was invited other than to try and set the stage. I wish I could say that I am as informed today as I was six years ago about this whole field of endeavor. I am sorry to say some things have passed by me because of many other areas to which I must pay attention now. I expect that one of the reasons I am here is because I have long been interested in innovations and felt that this whole area needed some thorough study. There are some real questions to be answered.

DAWSON: Thank you. Dr. Micheels has said something that is encouraging to me. I have long felt as a critic in the field of endeavor which we have called industrial arts--I am still not sure that is exactly the right name--that we needed people who were away from the field to help make the critical decisions. Dr. Micheel's removal from the curriculum detail may be to our advantage.

Dr. Edward F. Haskell is with the Council for Unified Research and Education, New York, New York. Dr. Haskell.

HASKELL: First of all I have to disclaim the doctor. I'm just mister. In my field there are no doctors. I specialize in the assembly of sciences and synthesis and thus far, there is no such department or degree, as far as I know. I suppose that's the reason I was invited here. Since you are thinking of new structures, new departures, it could be that this was on your minds.

I myself was delighted to be invited because it seems to me that the University bitterly and desperately needs a new structure just as it did in the early 17th century when great changes had occurred in science and new directions had been sketched out by Francis Bacon and Leibniz, Descartes, and others. At that time there was a great reorganization of the universities and it occurred partly from the outside. Since I have been partly on the outside of these universities, but constantly in touch with them, in trying to see what the new times call for, what the greatest defects are, I imagine that may be the reason I was invited here. At any rate that is the reason I accepted. I never heard of a university or college in recent centuries which had consciously decided to really seriously investigate the possibility of reorganizing. It seems like a golden opportunity which we ought to try to use to the best of our ability.

DAWSON: Thank you. Now we have Mr. David Allison, Contributing Editor of International Science and Technology. Mr. Allison, would you give us some information on yourself and why you're with us?

ALLISON: My background is in engineering. I am a writer in the field of technology. I'm interested in the question of innovation and how technology fits into our society. I can only conclude that I have been invited because someone has read what I have recently written and realized, as I do, that I'm more confused about how innovation works and how technology fits into society than I was a couple of years ago. So it may be someone's charity that has brought me here. I expect to learn more than I will contribute. But I think this may be a problem we all face in trying to see how this match between technology and society really works.

DAWSON: With this interrelationship between technology and social science, one can understand the problems that the field of education faces in attempting to lead millions of youngsters into creative and productive futures.

We're pleased to have with us tonight Dr. Bernard Muller-Thym. He is with the Graduate School of Business, Columbia University and a noted consultant to business and industry.

MULLER-THYM: I am one of those who came to be here because someone else couldn't come. When Paul DeVore got in touch with Donald Schon, Donald couln't come and suggested my name. Don and I have something in common. Our original work, in both instances, was in philosophy--with a fair amount in logic and in the philosophy of science. Both, Don and I have been interested in the whole process of the industrial setting beginning with the generation of new knowledge and proceeding through invention to innovation. Innovation is the process by which invention is brought to the market place. And so now, the whole process could be organized. Don, also, when he was Director of the Institute for Applied Technology in the Bureau of Standards, was a client of mine. When it was an issue of applied technology we had to ask the question, "What should such an institute be for and vis-a-vis how should it be organized?" In my own work, the mixture of my activity varies from year to year with about 80% consulting and about 20% teaching. I do not hold a regular appointment at Columbia. I have been a visiting professor at MIT for eleven years. I have close relationships with Columbia and take part in the executive programs but I am really strictly unclassified. My interests center around the computer technology, the dynamics of business, and the education and development of managerial professional people. To give you an idea of the range of things, I will mention some things I have been involved in since January. I spend about 2 days a week with a group--an experimental group--where we try to invent things. For example, there is a new machine that RCA has developed in the laboratory that they call Homafax which will be able to broadcast from a piece of visual copy to a piece of paper in your home. RCA did all the development and engineering on this and suddenly realized no one knew what it was for. So we have developed 10 programs that are specifically designed to test the characteristics of the new machine.

In working with the research labs at Northern Electric, we have been working on communication requirements for man living in society in the year N + 1. Our question is: "What would be the nature of the man-machine interface if you are concerned with helping man in many senses and not just in a single sense to a transducer?"

I was out last week to Sunnyvale with the Lockheed Missiles and Space Division and will continue to work there. There's really a very large and very powerful computer facility that turns out an incredible amount of work ranging all the way from routine and very large administrative tasks to fairly advanced scientific and engineering computations.

DAWSON: Thank you, sir. Now Dr. Bruce Sinclair, who is with the Department of History, Kansas State University, give us his background.

SINCLAIR: In the first instance, I am an American historian. My own undergraduate and graduate training was in that area, so that I approach the history of technology from that point of departure. That leads me to the consideration within the history of American technology of such things as the interrelationship between technological changes and their influences on society and culture. I do not, for example, approach the history of technology from the point of view of refinements in the machine tool industry or specific textile machine innovations. I am currently teaching at Kansas State University in the history of technology and the history of science. I hope that what I can contribute to the conference is some sense of how some of the things that you are talking about now and for the future were structured in the past.

DAWSON: Dr. John McHale is unable to meet with us but will make a presentation on tape. Dr. DeVore, will you please explain this part of the program?

DE VORE: We will hear from Dr. McHale tomorrow via tape recording. He was requested to work with us because of his work in the study of the energy systems, tool systems, and resources. He works directly with Mr. Fuller at Southern Illinois University. We have available for the conferees to review six of the volumes they have published as part of the World Resources Inventory Project. He was sorry he could not attend but did agree to set the stage on the subject of technology as he sees it. In fact, he was quite concerned, as we discussed the invitation by phone. The question he raised during one phone conversation was: "It's fine to philosophize about this but how do we get down to the nuts and bolts of teaching?" His overriding concern is the educational aspects of the problem.

DAWSON: Very good. Now I believe we have identified all of the consultants. We want to know something about our hosts. First, we'd like to ask Dr. DeVore, who is serving in his first year at West Virginia University, and is especially active in this project. Dr. DeVore, give us a bit of your background, if you will, and your interest in the present project.

DE VORE: I'm primarily an industrial arts teacher by background, having taught in public schools. I also spent three years in engineering education. For the last 11 years I have been in a program for the preparation of industrial arts teachers. I came to West Virginia this past fall to look at our field rather critically. I accepted the challenge and opportunity that Dr. Katz, Dr. Ikenberry, and Dr. Brennan of the College provided for analyzing and projecting a program of industrial arts teacher education for the future.

DAWSON: Thank you, Paul. Dr. Thomas Brennan has been at West Virginia University for several years and had an important voice in calling the moratorium on the program. Dr. Brennan, would you give us information about the University and some background concerning your personal desires and your work in the field over the past years.

BRENNAN: Ken, I wish I could. I think one of the reasons you folks are here is because I am confused and I have been confused for quite a long time. I have been at the University since 1941. During this time I've seen the industrial arts program grow from a program of about the size of 20 students to a program of some 40 students. This, in a period of 25 years, doesn't evidence very much growth. At the same time I saw a situation developing. It didn't look to me as though we were ever going to get much better. At this point I approached the administration with the idea. This was concurrent, incidentally, with the organization of the then College of Education into a College of Human Resources and Education. The time seemed to be right to approach the administration with the idea of reorganizing our program as well. In fact, I went to the point of suggesting that if they didn't feel it had any future we ought to do away with the program entirely--and for several reasons: economically speaking, it wasn't a good investment. We weren't making nearly the contribution which I thought we could, and I was perfectly willing to walk away from it. Our new Dean, whom you will meet tomorrow, didn't look at it in this fashion. I had spent a year and a half trying to give him a background on what industrial arts was, what it is, and what it should be, and we both came to the conclusion that neither of us knew what it was, or what it should be. So he suggested a moratorium on the students so that we might have an opportunity to study the program. We didn't have a large investment in the program and we didn't have a program of a size that it would make an impact on the University structure if it were discontinued. By the same token, there could be, in our own thinking, strengths. We didn't have to utilize, for instance, anything that we had. The program and physical facilities were expendable. In other words, if we were to declare a moratorium, and this was primarily to free the staff so they could study the problem; we wouldn't have to use an old program as a foundation. We wouldn't have to do a re-tooling job while we were still in an active program. This could be a clean sweep, you might say. This was a very unusual situation. To our knowledge, we haven't come across any other institution which has undertaken a curriculum revision with this kind of approach. We felt it was, because of its unusual nature, a virgin opportunity to do an unusual type of revision.

Before we get too far along I want to tell you about our observers. From time to time we will have several observers. In our original contacts with you I think we pointed out that the group would be small. We purposely kept it small so it could be intimate. These people have been asked because they either have a stake in industrial arts education or because they are on our staff and will eventually be involved in what we might do in the way of a curriculum project.

I was supposed to give you some idea, sort of set the stage for you, by talking a little about how industrial arts got itself in the fix that it is. And we really think it's in pretty much of a fix. Paul said--I think he was being overly caution when he said, he was a critic of our profession--I think both of us, to use his word, are rather mavericks in this field. The profession has been trying to reorganize our program for a long time but primarily we've been asking questions of ourselves. The profession believed it knew more about industrial arts than anybody else, so the question should be--ask our own people. It hasn't worked. Recently a research study from the U. S. Office of Education pointed out we're not doing things we said we should have been doing 20 years ago. We've done a corollary research here in our own area in Appalachia and find Appalachia is five years behind the national average. This is not the kind of a situation we thought could be perpetuated. However, we were perpetuating it--thus the reason, for bringing you folks together. We thought this would be an opportunity to get some fresh ideas.

You're already been told that Paul and I are working on the project. We are ably assisted, however, by our Director, who is with us tonight--Dr. William Katz. He has provided good moral support.

At this stage we're not going to try to tell you what we have been doing up until now. Actually I have been on this moratorium for two years--this is my second year. Last year I accomplished very little, with the exception of inveigling Paul to come down and be with us, which is probably the best thing that ever happened to me but we won't go into that. We have some definite ideas. Tomorrow evening Paul will give you a small presentation for background on our efforts to date. On Friday, we hope we can blend the two of them together with some recommendations. We don't intend, at this stage, to set up a pilot program. This isn't our thinking. Our charge is to develop a program of industrial arts teacher education designed to meet the needs of the future. This is a big order and the main reason we have invited this group of sages to this conference. Maybe they can help us identify the needs of the future. We are thinking of a study which will eventually culminate in a curriculum designed to produce a teacher capable of functioning in the society by contributing to that society materially because of his own particular expertise in one area of technology. We're not certain what the area ought to be. As Ken has said, maybe industrial arts is not the right term. If it is, we will call it so; if it isn't, we will coin a new word. We don't know where the background should come from. We have some ideas and we hope you will be able to give us some. The further we get into it, the more we realize the enormous proportions of it. We would like some recommendations, sometime along the line, on the limitations we might need to face. We hope to get that settled.

So you see we're sort of in a quandary. I used to tell my graduate students that if you get half way through the course and you still don't know what I'm trying to do, you're on solid ground--it's a good graduate course. If this has any grain of truth in it, I can certainly say Paul and I are in a good graduate course right now. We don't know where we're going to go. We hope to go some place. I'll leave it at that.

DAWSON: Thank you very much, Dr. Brennan.

HASKELL: Mr. Chairman, after hearing some of this it seems to me that I should identify my background a little better because I think I didn't do it adequately.

DAWSON: All right, we'll redo it, Mr. Haskell.

HASKELL: The thing is this. I became convinced around 1940 that the university in general was in the situation which you have just described abour your own university. I went to the head of my department at the University of Chicago--I was then in Anthropology--a graduate student after having done seven years of graduate work--and told him I wouldn't take a Ph.D. in Anthropology. One thing led to another and finally the University set up a special committee called the Interdivisional Committee for Unified Science, to permit me to fill in the gaps in my knowledge in any department in the University. They gave me a fellowship for three years so that I might study without too much financial pressure. I was very fortunate in having some of the leading professors in the country, perhaps in the world, on this committee, and in the University most generously helping in all these ways. By 1948 things had developed far enough so that I called a three day conference at the centenary celebration of the American Association for the Advancement of Science. And there we organized the Council for Unified Research and Education. This consisted of professors in various universities, each in a different department, working on a book which is now completed, called "Assembly of the Sciences." (That is to say, the first volume is complete. The second and third are not yet finished.) All these years we have been thinking precisely along the lines that Dr. DeVore and Dr. Brennan have been describing. So, I feel very much at home and I am delighted that I have this task. Perhaps we can share some of the outcomes of the many years of work that we have been doing along these lines.

DAWSON: Thank you, Mr. Haskell. Does anyone else want to add something to what he said before? If not, I want to ask Dr. Brennan to introduce the other guests who are with us tonight.

BRENNAN: Yes, of course. I'll have to start with my boss. Dr. Katz is sitting over here on the sofa. He is the Division Director, Division of Education, in the College of Human Resources and Education. It is in this area that industrial arts finds its home. Behind him in the straight chairs back there--the rather cherubic young man with black hair is Dwight Fowler who is the Director of the Technical and Industrial Arts Program at Fairmont State College--one of our sister institutions just about 20 miles down the river. With him is one of his instructors, Mr. James Hales, who is also one of the doctoral students in our program here at the University. We asked him to come because we think he might have a stake in this--we know we have a stake in him. And we thought this was a rare opportunity to have him on hand. Fortunately his president, who used to be my dean, has agreed to let him stay for the entire session. I don't know how long Dwight will be with us but he is welcome to stay as long as he wants. Incidentally, these people will be coming and going so don't feel if you are in the middle of a presentation, don't feel they are disgusted with you if they have to leave. It just might be that they have other responsibilities.

DAWSON: Thank you very much. I have asked you to do something that I suppose I should do myself--and give you some of the background as to the reason why I am here. Paul DeVore and I spent a year or two in close association while we were both working in the Washington, D. C., area, and we've philosophized long and hard about the field of industrial technology, industrial arts, science and technology, and what have you. And then two years ago this coming summer, Dr. Brennan was kind enough to invite me over as a visiting professor and we discussed industrial arts in some detail. But I think the real reason I am here is because of my interest in the field, and it is a deep and abiding interest. My background has been largely in the field of industrial arts although I am now in the School of Education at Morehead State University, in which, I might say, industrial arts does not find itself. It is not in my school but in applied science and technology. I did spend almost six years in Washington in the national office as the executive secretary-treasurer of the American Industrial Arts Association. I traveled in practically every state in the union, got into great numbers of colleges, secondary schools and elementary schools, and great varieties of programs of industrial arts. My experience causes me to have concern about the field. I can see a need for a study of industrial technology, as a major part of an individual's liberal education or general education. Technology is so all encompassing, it affects every individual in a number of ways.

One day I was talking with Dr. Peter Drucker in New York. He gave me great encouragement when he said something like this. "I have three daughters. I couldn't get them into programs of industrial arts as they reached the junior high school level so I worked diligently with the school board insisting that they be allowed to take industrial arts." Dr. Drucker realizes, along with you and me, that industrial arts, as we have known it, has been a rather weak offering in schools in many ways. But he said, "How can anyone say that he has a good liberal education today, in modern America, in an industrial democracy, without having pursued the study of technology which is the dominant characteristic of our culture?" Technology is the domain of what I call industrial arts. I believe that industrial arts can become a major curriculum area. By this I mean required of all boys and girls who are going to live, play, worship and work, and have their being in a technological society; a society which is becoming more involved each day. Without an understanding of this tremendous force called technology, how can one exist, live and be an intelligent consumer of the products of technology? From this vantage point the study of industrial arts and technology is just as important to the youth of today as is science, or mathematics, or any other phase of education. However, I am concerned that if we continue in the approach that we have used in industrial arts in the past, this area will fail to serve its purpose and will no longer continue to exist, and properly so, as a school program. We cannot continue having a program in schools, teaching outdated crafts or skills which provide very little for the present and even less for the future for a child. We are making some changes but they are slow and may not be of the right kind. So, one of the reasons I am here is my interest in a field which I believe has great potential for all boys and girls, regardless of what their future may be or their past may have been. Mr. Haskell raised the question anthropologically--"What has built civilization, anyway?" Has it been thoughts, ideas, and artifacts? There has been an increasing emphasis on technology to the point that the technology which we have now can literally destroy us--or make us even greater as a civilized people. But man must know about and understand technology if he is to control it and utilize it for the benefit of man.

I'm here because of interests. I'm here with gratitude that we have the opportunity to throw out ideas, pull others together, and maybe develop something that will provide answers to our questions.

DE VORE: I would like to make a few comments on what you have said. Basically all the problems, as we have analyzed them, as you have stated them, and as Dr. Brennan has indicated, are of great complexity. This undertaking is a massive task. To begin, we must analyze from a cultural base and then look at it as an educational problem. This is the relevance Dr. Drake and I discussed coming from the airport. If this group, which is an interdisciplinary group, can provide the direction and give us a meaningful base on which to move ahead, we will have accomplished a considerable amount in these two days. I would like to indicate one reason why this task challenges me more than any other. As one examines the problem through the study of a diverse number of publications, one finds the problem is not really a technical problem at all or even an implementation problem, but first, it is a human problem, a cultural problem concerning human beings. And I think the essential element, as we encounter the problem, is to examine the kind of life we want, the kind of educational system that directs attention to gaining this kind of life and then, if the area we are discussing and representing has meaning, to determine the elements, the relationships, and the contributions this area of study can make to the education of youth.

DAWSON: One further comment before we turn the program over to a couple of other people. While I was in Washington, I had the opportunity to discuss with many people what might happen in the field of industrial arts and how it could really become that which many of us so greatly desire. We conceived the idea of a national study. The ones of you who have worked in the field of industrial arts know that we worked hard trying to get a national commission in the field of industrial arts. We proposed a grant which would support a three or four year study of the total curriculum. The commission would have brought together an interdisciplinary group of people such as we have here tonight. I'm sure you're thinking of expanding this group as you continue into the future. I am convinced that a national study is essential and would perform the service, on the national level, which we hope to perform here. People outside the field of industrial arts must accept industrial arts and its content base technology as a discipline in its own right. It can become a discipline, just as mathematics is a discipline, if we can unify the content and strengthen our programs.

__DRAKE__: I guess I don't have a very clear definition of industrial arts as it presently exists. I like to think in terms of who are the people--what's their capability at the beginning of a program in industrial arts and what's their capability at the end of a program. I'd like to have a better feeling concerning what it is __now__, completely apart from what it might be in the future. Also what is the initial concept of the desired end result of a new industrial arts program?

__DAWSON__: That is our task here.

__DRAKE__: I know it is. However, I need some way of getting some bounds on the problem.

__DAWSON__: In my own belief, it may be best that you don't know what industrial arts is at this point. That may be the greatest strength that you can bring to us.

__DRAKE__: Let me phrase my question in a different way. Are we talking about educating the universal man? That's the framework that I have now. If not, what are some initial guidelines --even if we decide to reject them as this dialogue proceeds?

__DAWSON__: Dr. Micheels is going to talk about this in a formal presentation in a few moments. I would say that you have hit on one school of philosophy in industrial arts which is a minority thought, isn't it, Tom?

__BRENNAN__: I would think so.

__KATZ__: I wonder if I might say something--as an observer. I want to throw in a few things which appealed to me--or occurred to me--and straighten everyone out in terms of where I stand. I don't come from an industrial arts background. I am Director of the Division of Education at West Virginia University, having come essentially from a background of elementary education and particularly science education. In becoming director of education it means I have had to learn a lot about a lot of things I don't really have any real interest in. I could enumerate some of these things and point out at least for now that industrial arts is something that I have lately come to think about--and Tom, in a sense, has been my tutor. I hope I have been a gadfly like Tom because I haven't accepted what he's told me and he's certainly not accepted what I've told him.

But I am wondering, getting back to Bill Drake's point, essentially what are we trying to do with industrial arts and why are these people gathered? I think someone stated just a moment ago, perhaps it was Ken Dawson, that industrial arts can't go on like it has been. I guess I would certainly agree with this. I wonder if we might not also look at this from the point that here at West Virginia University we have some industrial arts people very much concerned with their field who are seeing themselves going down a road which is going to end very shortly. If so, where can the industrial arts teachers go? If there a field for them? Are the buggy whip manufacturers going to find some diversifications that will enable them to exist? In a sense I'd say that this is, in part, the interest the industrial arts people have in finding for themselves a new reason for existence. However, I think it goes much further than this. The self-educators I believe have more of an interest than just their selfish interest. They are concerned with education and what education is supposed to be. They're also saying that there's a new world we're facing and perhaps will face for a long time. We have not answered the question of how to develop the individual to compete, successfully, with the forces he will be facing. So, we have a group of industrial arts people and educators and a variety of other people who are going to examine the world and examine what has been in one sense, at least, a facing of a certain aspect of the world--a certain kind of education--industrial education or industrial arts, and they are asking, is there a role for these people? Is there some way of training the future teacher so he can have a reasonable existence or are we going to let these people live out their remaining years in the backlog of education? I'm sure there are still enough industrial arts jobs for the remainder of their lifetime and my lifetime, knowing the speed with which education progresses, and even for the new people being prepared right now. But they're not satisfied, and I'm not satisfied that the job of education is being done successfully. I would say that there is a place, and we'd like to find what this place is.

DAWSON: Does anyone else have another comment before we close this session?

DE VORE: I have one comment to make. I am not concerned with what industrial arts is or what it has been specifically. The field has reflected over the past number of years the same problem faced by all of education which has been the splitting off, the subdividing, and the increase in specialization to the point that it is possible for some students to complete a program of studies and come out with a very narrow comprehension and understanding of the world today and with a limited area of performance. The new doctoral program at the University of Michigan Dr. Drake and I have been discussing is just the opposite. This program brings together a whole host of interdisciplinary areas in order to turn out an individual who does comprehend what is going on.

HASKELL: Could you tell us a bit about this doctoral program?

DE VORE: Perhaps later we can. Dr. Drake described the program briefly and I saw reflected in the field which I represent, great similarity with the problems in other fields. Science is not teaching in many of the public school programs what science really is. Programs are more concerned with students becoming chemists than they are with the major questions that science should be asking. The same thing has happened in the humanities where we have chopped away and created smaller and smaller disciplines. The last college I was in they were talking about entire courses on one man's poetry at the junior year in college. This compartmentalization has also happened in our field. And it has happened because people are searching for answers without a meaningful base upon which to make curriculum judgments. Our task is to come to grips with the kind of education the future will require for all men and all women. This was Mr. Haskell's concern as we talked briefly over a cup of coffee earlier in the evening.

DAWSON: Dr. Micheels has been recognized for many years as one of the great leaders in the field of industrial arts. Long before he became president of the university, long before he became department chairman, Dr. Micheels had great stature in his field. Such things had come from him as the Minnesota Plan for Industrial Arts which for several years was almost a bible in several parts of the country. Dr. Micheels has served as president of the American Industrial Arts Association, he has served in overseas assignments, I believe, in both Europe and Asia in an advisory capacity in the field of industrial arts. It's a real privilege we have to hear one of the great speakers in the field of technology and industrial arts this evening. Dr. Micheels.

MICHEELS: I'm going to move over here--to get farther away from you. I'm not sure if that means I'm going to be far out or not. After listening to some of the things you have been saying, I cannot help but recall what I have told my faculty on a variety of occasions. As you know, as far as faculties are concerned, presidents are evil. So out of this grows a ritual. Each morning as I get up and go into the bathroom, I look into the mirror and say, "I am evil, I am evil, I am evil," and then I must look up a little farther and say, "Pray God, today may I be a necessary evil!" At this time of night I sort of feel like that--a necessary evil.

On Monday of this week we had a legislative tour of the campus. In the afternoon we held a public hearing on student housing at which time students, townspeople, renters, and so on could express their "gripes". Monday evening was the evening I had put aside to take my briefcase home and pull together some notes for this presentation, going over a series of notes that I had been making along the way. I guess you know that public hearings can be rather enervating, so when I started off, I didn't have much inspiration in terms of this assignment. And then I started out by reading Mr. Haskell's paper. Right away I felt even more forlorn that I hadn't had enough time to do more homework along the way.

But as luck would have it, I also had in my briefcase a report from the Center for Research and Development in Higher Education from the University of California. I started to read through a summary of a paper called "Inclusive Innovation" by Professor Warren Martin. This was a very lucky move as far as I was concerned because it seemed to me that he had some very significant comments and ideas that are very germain to the program we have here--the conference theme that we are embarking upon.

I choose at this point not to talk a great deal about industrial arts--I'd like to get a lick in as the conference goes along. In terms of the topic, "The University and Industrial Arts", I thought it much more appropriate that I think in the context of the perspective of the University today. This goes along with some of the comments you have been making with respect to where we are and the problems we have to attack as we gear up for the future. But also at this point I return to my undergraduate days. One of the most significant generalizations that I took from those experiences was a remark from a professor--and I can still see and hear him say "Make not less use of other men's ideas but more." And it is in this context that I propose to quote freely from Professor

Martin and others, interjecting a few comments of my own along the way.

But before we get over into the idea of the university and industrial arts, I think we ought to spend some time on the university and education generally, at this point and time. In his approach to "Inclusive Innovation" Mr. Martin starts out with a thought which I think we can all agree with--the most significant development in higher education during the past twenty years had not been the gadgetry, the hardware, the techniques, many of which are glamorous. Rather the greatest development has been in the realm of the mind and the spirit and has to do with ideas and personalities. I think we've been alluding to this, in a sense, this evening. He calls it the essentialist-existentialist confrontation. It is his thought that what we decide about this matter which involves our basic assumptions and purposes, will determine what we do with all other developments in higher education.

I think Mr. Martin has chosen very well with the expression "the essentialist-existentialist confrontation," and I would like to spend a few minutes on that. This confrontation is occurring not only in education but in other institutions in our society. And there is a definite relationship. Martin uses the field of architecture to illustrate the point. He specifically talks about the building which now houses the Yale School of Art and Architecture. This is the work of Paul Rudolph, an architect who has lately been challenging the status quo in his field. Now opponents say that this example of environmental architecture doesn't work. Rooms are too large or too small, not functional, and have an excess of gadgets or crannies or levels or nooks and all kinds of eccentric surprises. But adhering to the value of an industrial age, his opponents judge the building in terms of efficiency, "rentable footage for dollar invested." That, I guess, is a commercial expression.

On the other hand, advocates of Rudolph's work say that straight arrow functionalism ignores the fact that art should stimulate the emotions as well as the mind. What a building does to a personality is more important in their opinion than the way the building implements a person's work. Thus, they say Rudolph's involvement with technological function is always a secondary matter. It is the formal versus the vital that is the issue at the heart of this essentialist-existentialist confrontation. Whether the field of encounter be architecture, education, or religion, the confrontation is much the same. It seems to me that this is the issue that must be understood as we think about innovation in education and more specifically innovation in industrial arts education.

Essentialists in education are formalists who reach way back over time to the ancient Greeks. Rousseau, Hagel, Kant, Mill, Locke, and Augustine, all the way back to Aristotle and Plato and even before that time. Whether they are idealists, emphasizing ideas and forces that transcend the particulars of human existence or whether they are realists, concentrating on men and affairs in and of this world, essentialists are concerned with that which goes beyond time and place, for that which is permanent, uniform, rational, sure. The existentialists, on the other hand, center their attention on man as man. They see philosophy and education as efforts to give rational form to a vision that must be, finally, very intensely personal. Only so, they say, can it be vital.

Behind some of the current thinkers in this area we have such names as Kierkegaard, Pascal, Montaine, Rousseau and Augustine. Some writers are saying that Augustine is an example of how it is possible to have a foot in each camp. But it goes back to even Socrates and Job. For example, when Socrates acted as an intellectual gadfly to his fellow Athenians, asking questions that challenged assumptions, getting citizens to determine individually what they believed, emphasizing the process of investigation more than the acquisition of knowledge, he was a forerunner of existentialism.

Essentialists in education contend that there is a specific body of knowledge to be taught and learned. That human nature is the same in every era--that tradition, ceremony, history and experience are worthy teachers. So, subject matter, standards, prerequisites, sequences--these are the essentialists' concerns. They also emphasize the disciplines and protect the departmental style of life. I suppose they might say with the English, and perhaps you all have heard this, "When it is not necessary to change, it is necessary not to change." The essentialists' extreme is illustrated by the annual deluge of books by academicians that are, in the familiar word, competent. Critical reviews of them begin "This is a competent book." And end, "One wonders why he took the trouble to write it." You've read these as well as I have.

I hope you know by now that I am trying to be formally informal but I'm primarily trying to throw out ideas rather than to present any sort of a definitive paper. And sometimes these ideas may not seem to be well connected and I don't think that's my purpose here tonight.

I think very important, though, is for each of us to think as some writers have been emphasizing recently; that western man has been slowly moving out of the medieval matrix, that is, the complex of state, church, arrangements by which all of man's life was dignified and controlled. He is moving into a position of increasing autonomy. Now, stripped of that traditional consolation that man had, he stands naked and alone, in a sense, thrilled by his freedom but terrified too. I think we see some feelings of this kind emerging on almost all of our campuses, as exemplified by the actions undertaken by some of our student activists around the country. Absolute certainties are gone, and only provisional certitudes remain. But from the existentialist point of view, these are enough they argue, if man can develop a tolerance for ambiguity. Indeed it may be in this area that his strength should be developed. I sort of like that thought. One writer says the only advantage the human mind has over the computer, is the mind's ability to work with vague, ambiguous, even contradictory problems. In past centuries, to maintain human supremacy over the environment, man utilized his brains to unscramble complex issues. In the future, supremacy may depend on his ability to scramble things up again, making work for man that the computers cannot handle.

Existentialists would agree with Gibbon, that the study of the classics may have retarded rather than hastened the intellectual development of the west. Another writer states: "The authority of the ancients and of Aristotle, in particular, drove culture into a rut and during the 16th century the University of Paris turned out almost nothing but bookworms and pedants." It is to avoid such a fate, without ignoring history, that existentialists emphasize that knowing and evaluating are both facets of the learning process.

Essentialists' pedagogy has stressed the accumulative side. Now existentialists stress the affective aspects of behavior. To existentialists, what is said in class by the professor becomes much less important than what is heard by the student. At the risk of digressing here, I want to report that I tried to get a step ahead of our students this year. In my opening convocation talk, using the powers of my office, without going through the curriculum committee, we introduced a new course called "Individual Experiences in Learning." I am the sponsor of that course. Notice I said I'm not the teacher. To begin with we called it an experimental course. It's limited to juniors and seniors. We have 19 or 20 in it with a lot more requests for next year. But this is a course in which the students make all of the decisions. As I said, I am only the sponsor, to call them together. They can come in and talk with me whenever they want to. This is a good example of having fun with students and freedom. They didn't even want to have a chairman. One girl said "All I do is call them together when we want to have a meeting." They met with me twice. I asked the Vice President for Academic Affairs to sit in on the first one to listen and help me register. The only requirement of the course is that they have to study something in depth--I don't care what it is--they can do it as a group or may decide to do it as individuals. The only other requirement is a written self-evaluation of their learning experience. And then if they hand it in, they automatically get three elective credits.

There are no marks--they will not be graded in any way. If, in terms of tradition, in terms of the essentialists, they feel they need a mark because of the grade point average, then a committee of their peers will read the report and give them a mark. This has been very interesting.

The second meeting I asked the Vice President for Student Services to sit in, to listen only. All I have to do is listen, and respond to their questions. I gave them one sheet on how you go about organizing a course of study, setting up objectives, what kind of behavior do you want to exhibit at the end of this experience, and so on. Right away one of the girls said, "We don't want that--those are rules!" I told them "No these are not rules, but you don't have to accept anything in here if you don't want to. They are suggestions if you want them." Well they talked and argued and they'll be back next week I think, just to come in to the president's office or conference room. The Vice President for Student Services said, and I hadn't thought of it, "You know that was the best example of what we try to teach when we talk about group therapy."

The faculty senate president came up to me and said, "You know a psychiatrist friend of mine says one of those girls in there is one of his patients and the experience she is having is much better than anything he has been able to do for her." I hadn't realized it, but I had a selfish motive--to get one step ahead of these students before they started saying "We want to have something to say in classes." I'd like to talk more about that with some of you if you are interested.

I think we would all have to agree, that the climate of learning in the house of intellect is today pretty much influenced by the essentialists. Another writer used these words: "The essentialists--they set the thermostat, but their efforts at climate control are being increasingly disrupted by existentialists who keep opening windows to let in fresh air."

Now I think we come to an important part of this conference. I think we can all agree that these are times of disquietude, education wise, times brought about by radical changes which are external to education, particularly the shift into a post industrial, nuclear, electronic effort which you have been referring to. In this context it is not surprising that there is broad-faced interest in innovation. With the essentialists, it is directed toward new means to traditional ends, while existentialists are more likely to be interested in new means to new ends. But with both I think we would have to say there is curiosity, at least, about innovation. I think this conference is an excellent exemplification of that. With the essentialists pretty much in control, it might be pointed out that the innovative process today is characterized by changes within systems rather than of systems, or changes reached by concensus and implemented with a minimum of tension and risk. Or changes that sustain the status quo by conforming to prevailing values. Existentialists, given their value, may be expected to favor curriculum variations that show promise of freeing the individual from the dominance of the institution. Independent study or the use of non-intellective variables in the selection of students, in the evaluation of their work and in the whole community concept of academic government. I think these people would probably say they would call for new learning configurations.

Now I go back to Professor Martin who points out that what we need in America in higher education now, given the situation, are innovators who think inclusively about the prospects for innovations. Thinking inclusively involves sufficient philosophical scope to see that the present climate of learning is influenced by the essentialist-existentialist confrontation. To appraise the strengths and the weaknesses of both sides and to enlist the skills of both to attain desired goals is what we should aim for. So much of our innovative effort is just patchy, in pieces, or it is of limited vision and does not foresee the consequences. Partial, piecemeal innovation, I suppose, is better than none. It may help to envision the possibilities. But it is quite evident, I think, to many many people that there is a paucity of radical change in higher education, at a time when the conviction grows that radical change is needed. That is why inclusive innovation is the kind that really matters now and why we must find innovators with the courage and audacity to try it. It seems to me that this is the kind of situation in which you find yourselves here in West Virginia--a healthy, stimulating situation, specifically in this instance, with respect to industrial arts.

It seems to me that you have accepted the type of challenge to which I have just referred and to which Professor Haskell has alluded to several times. And this is both an interesting and exhilarating feeling to a person coming from the outside. One of the important--perhaps the most important--functions of a university is to utilize its total resources and address itself to the problems of teacher education, at all levels, from preschool to graduate school, from the cradle to the grave. One of the sad commentaries, in my opinion, on the history of education is the secondary role or the insignificant role which our so-called academicians have placed on the preparation of teachers, especially for the elementary and secondary schools. We all know, of course, of the significant strides that have been made in the last few years in the areas of research and development relating to education. But these efforts are significant only in relation to what had gone before. Actually they are "piddling" when one considers the frontiers that lie before us as we struggle to learn about learning, with all that it implies.

Recently, of course, there have been some changes in attitude, starting I suppose with Sputnik. And this is good--as far as it goes. Academicians in some areas have come forward to serve as the saviors of certain subject matter disciplines. Again I say this is good. I think they should come forward hat in hand and apologetic for they should have been a part of the team all along. This is perhaps an odd way to put it but it is a thought that struck me in generalizing on the fact that the entire resources of the university should be employed in the evolvement of new programs for the preparation of teachers in our case, the preparation of industrial arts teachers. To use an old expression, I think, of Walter Lipman's, "We have learned that we can afford to defend ourselves wherever and however and whatever the cost. By the same token we must learn that we can afford to educate our citizens the way they need to be educated regardless of the cost." How else can we do this, other than by utilizing the full resources of the university as well as other institutions? Should West Virginia University commit itself to a program of industrial arts teacher education? My answer, perhaps it's prejudiced, is a resounding yes. I guess this is the question which represents the theme of the day. At the outset I want to commend whoever it might be who had the "guts" to declare a moratorium on industrial arts education but with the enlightened provision of let's take an objective look-see and let the chips fall where they may. Perhaps some people were hurt, but in my opinion this ought to happen in every area of study in every one of our institutions.

I guess what we're saying here is that if we have a responsibility and a contribution to make, let's find out how we can plan the best, rather than grope along with mediocrity. In this connection and this is the one allusion I am going to make now to industrial arts, it seems to me that if you have not already done it, and I take it you haven't done it, the very important first order of business will be to evolve an operational definition of industrial arts as an intricate part of the learning experiences which our young people ought to have in our schools. I wonder if this would be a part of the eco system which you talked about, Professor Haskell? I had to go to the dictionary on that one but I'm looking forward to hearing more about it.

But the evolvement of this definition, I think, should be an interdisciplinary effort with a disregard for the so-called definitions which are presently in existence. There are many additional questions I would like to ask but with that, I am going to stop, having talked a little longer than I had planned. I would finish simply by asking how can you at West Virginia University exploit the wisdom of all the resources that are available to you--both within and without the university? We ought to get some answers to that question in the next day and a half. Having said that, and having made some utterances perhaps outside my field of scholarly competence, I feel somewhat like the chimpanzee who was found in his cage in the zoo with a Bible in one hand and Darwin's "Origin of Species" in the other. When he was asked what was troubling him, he said, "I am bothered. I don't know whether I am my brother's keeper, or my keeper's brother." I think we have some similar problems to wrestle with here.

DAWSON: Thank you very much for setting the stage for us for the next two days--we may have to be our brother's keeper or our keeper's brother--I don't know.

DAWSON: Dr. Haskell?

HASKELL: I would like to ask Dr. Micheels whether he would comment on the parallel that seems to exist between his two groups of people--essentialists and existentialists--and what Ruth Benedict, following Nietche, called Appolonians and Dyonysians. In her book, "Patterns of Culture", she described some people, as for example, the Hoppi Indians as Appolonian. They were sober, they had a very stable society and seemed, as far as I can see, to correspond to what you defined as essentialists. Then she described other Plains Indians--Apache and Arapaho and so on who were very war-like, who went to excessive extremes in many directions, including drunkenness and use of piotti and other drugs, and who loved tremendous exploits and to go out of the bounds of the tradition and so on, to discover new things. These she classified as Dyonysians. Do you think there is any validity in this parallel?

MICHEELS: I expect there is some. I'm not enough of an anthropologist to really carry this through. But as you were talking about some of these people, I would certainly call them existentialists. I think this whole concept of treating man as man would have to be the basic premise upon which you would make a comparison as opposed to the essentialist structure which is something other than man as man as used as a basis for organizing a subject matter structure or organization. I suppose you could find some comparison.

SINCLAIR: It's not just a case of juxtaposing revelers or rationalists.

MICHEELS: That's true, absolutely.

DE VORE: One of the problems of the essentialist looking at the existentialist, is that he would use the approach of the essentialist. Truth is objective. The existentialist will say it is subjective. You can interpret the universe with the concept that things are rational and can be organized. Most of us face a true dichotomy, with a foot in each camp. What are the elements that you can really pin down and say this is the structure? As you look at the history, things keep changing and new truths are found. What was true changes. This is the existentialist philosophy. It is subjective--it is of the mind and as human beings change, and as they have new experiences, then the truth changes for them.

MICHEELS: Again I mention Augustine and the possibility of having one foot in each camp--the thought that strikes me there is how we might do this. Change to me is one of the basic qualities. Some people are loathe to make changes in certain areas but are willing to make changes in others. Another comparison that came to my mind is the fact that some scientists are very objective in approaching their particular discipline. When they get over to criticizing another discipline, they sometimes get way out.

DE VORE: I wonder what Dr. Drake has to say in terms of the urban problem as it relates to this--the objectivity, knowing that such and such is possible, but then recognizing the various elements which relate to value judgments.

DRAKE: It seems to me that one of the problems facing universities is to what extent the university should become involved in attempting to solve or work on urban and regional problems. That question has been raised at Michigan. More and more I am convinced that analyzing urban problems, defined as urban problems, is something like closing the barn door after the horse is already out. Many problems manifest themselves in urban regions because that's where the people are. I don't think that even the most knowledgeable urbanologists (that's a yet to be defined term) have been able to define adequately just what some of the problems are.

MICHEELS: One of the situations and problems from where I sit is related directly to the faculty. You know how difficult it is to change a faculty, especially when they are reaching to a faculty member who has completely new ideas and is anxious to start out. If he can start out in his own niche, that's fine. But when it comes to interaction with other people who must cooperate with a particular program--whatever it is--this is where he runs into difficulty.

DRAKE: I find that what helps me is to set up some kind of a straw man--if for no other reason than to knock him down. I think the idea of getting an operational definition on what industrial arts is now and/or what it might be in the future is very important. Do you think we could do that tonight?

SINCLAIR: The 19th century didn't have this problem at all. When the 19th century talked of mechanical arts, the term encompassed not only the subject content, but an objective as far as society was concerned--it was all wrapped up very clearly.

DE VORE: Perhaps I should give you more information on Dr. Sinclair's background since he didn't tell all. He's an historian of technical education. Also he did work at the Franklin Institute in Philadelphia. You did your thesis--your doctoral--in this area, didn't you? This gives us some perspective, you see, on what the problem is today in relation to the historical past.

SINCLAIR: I was struck by a couple of things in Dr. Micheels' talk. One of them is that this traditional approach as opposed to individualistic, emotional approach has an analog in the 19th century. In a sense, the people who were then concerned with initiating programs of mechanic arts for education were really educational reformers. By and large they were unknowns, people who were trying to work against formalistic educational patterns and who concerned themselves with the problem of relating education to immediate human needs, and especially the needs of American society.

MICHEELS: Yes, this debate continued for quite some time at high levels. Nicholas Murray Butler spoke of this at a national meeting of the National Education Association.

SINCLAIR: The interesting thing I want to point out is that we can't even talk about it now because we don't have a set of words that says what you want to say.

DAWSON: Dr. Haskell mentioned a moment ago Ruth Benedict's writing, especially Patterns of Culture. I think this gives us a foundation. To me this is one of the best industrial arts books that I have ever seen. She talks about a child, a product of his culture, and how he picks up his habits and beliefs from the culture. She says that a child born in another part of the world cannot obtain one thousandth part of another culture. There is a cultural heritage in a technological society that we should help our children obtain. And maybe this could be a part of the foundation for industrial arts.

DE VORE: In terms of an operational definition, I would refer you to this publication*, without trying to say this is the definition. If you'd like to take this with you this evening and look at it, you will find definitions in it. Also this study sets the stage for what seems to be asked for--and what Dr. Micheels has recommended--objectives we should accomplish. Our concern, however, is that the objectives say one thing and we appear to be doing something entirely different.

DAWSON: I believe we have had in the field of industrial arts, since the early 1940's, objectives which have been rather noble. They are the types of things that most people would like to see in industrial arts, but we simply have not implemented more than one or two of them at the most. The four objectives in the U.S.O.E. publication are probably the best accepted of any that have ever been written.

BRENNAN: The blue book* will indicate an almost direct relationship between the objectives that were proposed four or five years earlier and publication Improving Industrial Arts Teaching that Dr. DeVore just gave you. The national survey indicated the four top objectives, as understood by the teachers, were almost identical with what the professionals said they should be. But the research also goes on to point out that although we all concur that these are the objectives, we really aren't doing anything about it.

DAWSON: Having some background in the field of industrial arts, I would be one of the first to say that I am very skeptical of what industrial arts teachers say about their field, as I am, frankly, about science and about some other fields. I think sometimes the industrial arts people have the biggest haze over their heads of any group trying to determine what industrial arts should be. I think we are too close to it--are too narrow. I say we--I still relate myself to the field--

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*Schmitt, Marshall. Improving Industrial Arts Teaching. Washington, D.C.: USOE. United States Government Printing Office, 1962.

*Schmitt, Marshall. Industrial Arts Education. A Survey of Programs, Teachers, Students and Curriculum. Washington, D.C.: United States Government Printing Office, 1962.

are too narrow in our approach and we don't stand far enough away to take a good look at the field. The school administrator, for example, has had a better idea of what industrial arts should be and what it does than industrial arts teachers themselves.

DE VORE: I have asked the national office of the AIAA for copies of the last national convention proceedings. The theme of the last national conference, representing the American Industrial Arts Association--40,000 industrial arts teachers--was "Industrial Arts and Technology--Past, Present, and Future." If you will just leaf through the proceeding you will obtain a perspective of what is being said in the field and what is being done. As you go through this you go from a projected image in the beginning of what it should be to the section where people in the field present some papers. This provides you with the specifics of what is projected and what is actual. It's a good perspective of the field of endeavor.

DAWSON: I believe we need an assignment, a basis for our work tomorrow. There is no structure, to my knowledge, for the conference. We need to determine what needs to be done for our first general session. I would encourage you to come in tomorrow with at least an idea or two of the specifics. Bud gave us one tonight, an operational definition of the field. What are the things we can do best with our time while we are here?

IKENBERRY: Our historian (Bruce Sinclair) described the people who were groundbreakers in industrial arts in the 19th century. He described what they were trying to do and I thought he stated very well what we are trying to do here and now. He said very simply, and yet profoundly, that they were trying to relate education to meeting the human needs. This is all they were trying to do--relate education of that day to immediate human needs. If I could summarize my concern in terms of questions that I am worried about, it concerns education at all levels, but particularly the high school and perhaps the college level as it relates to teacher education. How can education be developed to meet the pressing human needs? And again how can we relate this connotation to industrial arts? Sometime I'd like to ask this group of experts--some of the same kinds of simple minded questions I've been asking Paul, Tom, Bill and others now and then. What are the objectives of industrial arts really--not just what sounds good but what do you really believe they ought to be to meet these pressing human needs our historian has stated so well? And another simple minded question--what kind of a teacher training program would equip a human being to work in a way in which he could meet these human needs?

DAWSON: You know, Dean, I think what you have said carries over into every field of education. Maybe we should start with a child and build him up with his needs, rather than start from where we are. We are actually working backwards in a sense. We are starting with a curriculum and working it back to the students. We need to start with the student, and work to make him the great individual, creatively and otherwise, that we can make him. And what are the areas of rationalism, logic, etc., that would build for this individual the things that he needs, in every respect? Then where does industrial arts fit in along with other subjects?

MULLER-THYM: This is just a footnote. There is a book that I would like to call to our attention which because of our various backgrounds, will be familiar to some but possibly not to others. Eric Pavloff, Preface to Plato, Harvard University Press. Pavloff describes the thing that really happens in Plato; the confrontation of the Greek world when asked to break the tradition from the oral where the poets were a traveling encyclopedia to one dominated by writing on paper, the appearances of the technologies, sciences and arts. The magnitude of the stress of this confrontation was considerable. This generates some of the uncertainties that you were talking about.

DAWSON: Thank you. Anyone else?

HASKELL: We have heard about the purpose for which industrial arts was developed in the last century. I wonder if the Danish Folk School Movement was perhaps not one of the expressions of that general trend where young people--peasant, farmer people, in Denmark--were given an opportunity to relate the work of the field to their classrooms, and thus bring theory and practice into mutual figuration and thus make theory more meaningful and practical. This was one of the great rehabilitative forces of the time in Denmark, which had suffered great reversals in the preceding decades. It seems to me that not only then but at anytime in human history, this has been the essential thing--to help young people learn--to teach them how to live.

DAWSON: We thank all of you very much. We'll meet back here in the same room at 9:00 o'clock tomorrow morning.

THURSDAY MORNING
November 9, 1967

DAWSON: This is Thursday morning, the ninth of November. The Industrial Arts Undergraduate Program Development Conference is in session.

For our first presentation this morning, Dr. DeVore will introduce the speaker.

DE VORE: The presentation by Dr. McHale is taped because of a schedule problem. Dr. McHale is from Southern Illinois University and is working--as we noted last night--with Mr. Fuller. John is interested in industrial arts teacher education. He agreed to present this tape to us on the topic of technology and education. We will let him speak for himself.

MC HALE:

CONSIDERATION FOR THE FUTURE: TECHNOLOGY AND CHANGE

I think our first thoughts should be directed to what we mean by industrial arts. I suspect that this term and the area that it defines is actually a hangover from an earlier period when it was felt, perhaps, that the school could, and should, provide such training in a range of practical skills, in preparing people for the kinds of 'slots' they would fit into in industrial occupations. Specifically, perhaps, the term industrial arts was adopted as an advance on the older 'arts and crafts' course; the use of 'industrial' connotes a shift from hand-crafts toward the use of those tools which would give some 'working' acquaintance with the actual industrial process.

The core idea is vocational, in the sense of training students for technical occupations or at least give some orientation towards this. We might examine the relevance of such an orientation now, of training for a specifically narrow range of technical vocations. While the industrial emphasis may be salutary, I think that the idea of skill training in actual production tools is somewhat misplaced in a college curriculum. No school now could hope to dispose of the range of tools which are deployed industrially or set itself up, as it were, as a kind of miniature training factory, one which would show and display and train in a whole series of industrial production tools towards acquainting the student with what we are referring to as industrial arts. Not only is the range of such tools too great now, but the complex independence of the whole industrial complex goes far beyond what may be supplied in the school workshop.

So the task is obviously a quite different one from what it might have been say 20 years ago, or even 10 years ago. Within the last 10 years a great deal of the actual character of the industrial process has changed. Considerable sectors have moved quite swiftly in this 10 year period into automated production. This is a feature which could not have been taken care of in the earlier industrial arts orientation. Here I'm hinting at a basic difficulty in the vocational sense--where you may train a person for a particular machine task in industrial arts today which may, even at the time of training be quite obsolete in that sector of the industry to which it was directed. If not already obsolete, it may be so by the time the person has finished his training--or in another period of 5, 10, 15 years' time. You have to project, as it were, almost immediately into the future. Industrial technology is changing, has changed very swiftly and will continue to change considerably in the next few decades.

Clearly, then, we can't approach our topic in the light of any piecemeal revision of any given industrial arts program, as some sort of self-contained course of skill-training in sort of quasi-industrial tool manipulation. It's not really a skill-training course at all. It's something quite different. What that 'quite different' is we need to discuss. As I see it, we need to review what we might mean by industrial arts. If we mean by this an area of study and exploratory experience, which will inform the student about the industrial process and all its ramifications, then we have a quite different sort of task in hand than that simply of revising an industrial arts program. We have to structure an educational experience which will communicate to the student:

(1) The phenomenon of industrialization itself--by no means a simple one. Our view of the way in which tools have evolved in relation to social development and in relation to human development generally has changed a great deal in the last few decades. So one of our first

tasks is to communicate 'the sense' of this evolutionary phenomenon in relation to society, i.e., industrialization itself.

(2) The specific relationship of industrial technology to society, to science, and to the interaction of all these three processes. We may note here, that science and technology are the major change agencies in contemporary society. In effect, these agencies--science and technology--are those which have made our present global society a reality.

This seems to suggest that rather than being a kind of course added to an existing curricula, it cuts rather deep into the heart of the whole curricula of educational process itself. It suggests also, that we require as clear a knowledge of 'industrial arts' as we need a clear knowledge of the development, uses, and the overall parameters of science--or of the humanities, for that matter. Indeed 'industrial arts', even in the way that we use the phrase as 'industry' and 'arts', may suggest that here is a crossing point where we may bridge the so-called two cultures dichotomy. I am suggesting, therefore, that such a 'bridge course' within the curriculum would be one around which many other types of courses, or educational experiences, could revolve.

(3) Skill training. Though we may suggest that the issue of skill training is not relevant in any real 'specialist' sense, we still need to acquaint the student in this area with sufficient knowledge of specific industrial and technological processes, if for no other reason that he may understand more fully the nature of modern industrial production in relation to society.

Area number 1, the phenomenon of industrialization itself and area 2, relation of industrial technology to society, would correspond to the phrase "intellectual knowing." And 3, the acquainting of the student with sufficient practical knowledge, etc., would correspond to "intellectual know-how," as distinct from "knowing about."

One suggests then that the intellectual knowing comes first. But we may more properly structure the curriculum so that both 'knowing-about' and 'knowing-how' are part of the same integral experience.

For the purpose of immediate discussion, however, it may be more useful to deal first with the intellectual "knowing" area. Here I think we need to devote our attention, quite specifically, toward communicating to the student the largest overall picture of technological development. Almost immediately we note that this broadly encompasses, not only the development of technology in industry, not only the development of particular kinds of tools or of particular kinds of processes or the development of tools in the industrial revolution or the way in which they become embodied in the contemporary machine tool complex--but rather more, the philosophical question of the development of technology itself--of the evolution of technology in relation to the evolution of human society.

That may seem a tall order but I think it's essential to any real understanding of the nature of industrial technological development. Obviously, such an overview seems a massive task if considered as a compilation of all the specialist and scientific disciplines or of all the specific technological processes and their development. It is not suggested in this sense, as a piecing together of all of such specialist course fragments. It is, rather more simply, a course of study exploration which attempts to view all the separate pieces and all the departmentalized and disciplinary fragments within one whole schema or pattern. Phrased this way it is no more of an impossible task than that which is connoted, say, by the term industrial arts.

How might we approach such an overview? Here I would like to cite the program with which we have been concerned for the past 5 years--"World Resources Inventory of Human Trends and Needs." This program not only asks the same questions that we're asking here, i.e., how can you approach some sort of overview of the development of society and technology--but it has produced a set of guide materials oriented toward providing such an overview of the whole, with particular emphasis on the role of industrialization.

The program originates with the proposal by Buckminster Fuller to the world architectural and planning schools in 1961 suggesting that they engage with a massive study of what you might indeed phrase as the 'industrial arts'.

> How to make the world work--how to redesign the world's prime tool network and environment facilities so as to make the world's total resources, now serving only 40 percent, serve 100% through competent scientific design and anticipatory planning.

We may note, initially, that the phrase, design science, may indeed be used to subsume the term industrial arts, in a much more comprehensive and disciplinary framework, one which pre-supposes a whole view of industry and technology as an evolutionary phenomenon, and as susceptible to consideration within a kind of generalized systems approach. You will find that our 5 two-year phase programming provides the beginning outline for such an 'overview' orientation.

The five two-year stages of the program, which follow, should be considered as overlapping and interweaving--their given order only indicates prior emphasis for consideration.

Phase 1. World Literacy re World Problems - World Industrio-Economic Literacy and its design science solution by dramatic educational tools for realization of the world resources inventory of human trends and needs--world's people. Together with dramatic indication of potential solution, by design science upping of the overall performance of world resource units to serve 100 percent instead of the present 44 percent of humanity.

Phase 2. Prime Movers and Prime Metals - Review and analysis of world energy resources differentiation between "income" and "capital" energies--design of more efficient utilization. Analysis of circulation and scrap recycling of prime metals. Redesign towards comprehensive and more efficient use and reuse "assemblies" with higher extraction of performance per unit of all invested prime metals in use.

Phase 3. Tool Evolution - Differentiation and evolution of machine tools--the integration of these tools into the industrial complex; review and analysis of generalized and specialized tools--automated processes and control systems--redesign and replanning of total world tool complexes and instrumentation systems, i.e., total buildings, jig assembled by computer within optimum environment control, air delivered, ready to use in one helilift.

Phase 4. The Service Industries - Analysis of world network of service industries, i.e., telephone, airways, communication services, hoteling, universities. General extension of dynamic network operating principles into formerly "static" areas of environment control both internal and external. Frequency modulated, - world planning of three shift, 24-hour use of facilities, i.e., most industrial facilities as yet operating under obsolete agricultural dawn to dusk, single frequency usage. Transsonic 1800 mph air travel transcends day-night and seasonal characteristics. Men literally jump out of night into day and out of winter into summer in minutes. Thus, local patterns of facilities employment trending swiftly into 24-hour success of users, i.e., electrically lit telephone booths by roadside.

Phase 5. The Evoluting Contact Products - Usually phrased as "end products" -- there are, in effect, no end products but only the contact instruments of industrializations human ecology services which are the plug-in or latch-on terminals of service industries, e.g., the telephone, transportation and other communication units, the motel (bathroom and bed) - and eventually the world-around environ control service unit.

Phase I. One may think of this as a basic course strand running through the whole of the curriculum. It begins with "World Literacy re World Problems" -- that is world industrial literacy and design science "solutions" via dramatic educational tools through which there may be communicated the world resources inventory of world trends and needs.

In essence, what it asks here is:

(a) How do you communicate?
(b) What are the major problems of the world?
(c) What kinds of technologies and resources do we dispose of for their solution?

This starts off with where the student is. In effect, it takes the daily newspaper, as it were, or the television news, and it starts off at this particular point and asks what are the problems in the world--which of those problems are susceptible to technological solutions? Which of them indeed may arise from the use of specific kinds of technologies?

The student is taken into the subject area of the educational experience via his own immediate experience. This seems salutary and a very exciting way of keeping the course work close to reality. As each problem emerges, e.g., the problem of pollution in the cities, it provides the focus for a series of discussions relating some particular lines of technological development together. The development of the automobile and its urban relations as it approaches very large scale production and use is discussed in relation to urban pollution, to the urban phenomenon in general, etc. You see how one can lead off into all sorts of side channels here for particular kinds of discussions and diversifications from any one given problem--returning always to a view of the whole.

Even if you are merely examining the automobile, and urbanization, this leads outwardly to the largest extents of the problem--at the world level. Hence our emphasis here on the first phase, World Literacy re World Problems -- suggesting the need for all people to understand the broadest, the largest, the most critical parameters of the problems that face us. We, of course, are emphasizing the point here, that none of these problems are peculiar to any one nation or any one region of the world. Because of the complex interdependencies of all nations that they are, in effect, global problems. We may note this particularly in using this example of the city--the overcrowding of urban facilities, the degree of urbanization is a problem all over the world, not only the developed nations but even more, in the developing nations.

I should emphasize before touching on phase 2 that one doesn't see these actually as separate phases, other than on the programmatic side. It may be a question of setting up priorities--what are the first things you deal with, what are the second things you deal with? These should be thought of as interweaving together, as with the first phase.

Phase 2 in our program is called Prime Movers and Prime Metals--which might be termed energy and materials in a broader and more generalized investigation. This proceeds via the review and analysis of world energy and resources towards the design of more efficient utilization of our resources--i.e., the analysis of the cycling and scrap recycling of prime metal, with its corollary the redesign toward more comprehensive and more efficient use and reuse assembly of such metals or materials toward higher performance, so as to serve greater numbers of people.

In this phase, we have the two related strands of historical development in relation to the society. The development of prime movers or energy conversion. We can cite energy conversion in the natural world--at the level of photosynthesis in plants, etc., and energy conversion in animals. Then there is man himself as an energy converter--with the use of materials in energy conversion, the use of levers, of mechanisms, of agricultural devices, etc., this leads simply into phase 3--the evolution of tools as they fit into the history of energy conversion. So we can see how the two phases interweave together.

In phase 3, Tool Evolution, we have a strand which concentrates on the evolution of craft to machine tools and the integration of these tools into the industrialized complex. We get into this by way of review and analysis of the whole development of generalized and specialized tools, of the types of families of tools that develop.

We may view technology here not as a kind of unnatural development overlaid on the natural world--on nature itself--but rather more, as part of organic development, a part of the evolutionary development of the human organism. Just as the crab has developed a particular kind of shell, a particular kind of carapace, claws, and an external exoskeleton, so man has developed naturally and organically a whole series of externalized carapaces--his clothes, his houses, his traveling houses, automobiles, airliners, oceanliners, and so on. By treating technology as a such organic evolutionary strand, it becomes much easier to understand. It is easier to integrate the understanding of tool evolution, of technological development, as an extension of 'natural' biological evolution. You can make many more analogies which make the whole process more understandable, and easier to grásp within this kind of view of the whole historical process.

For example, the evolution of tools may proceed in swift review from the development of the first hand tool quite swiftly up to the development of the machine tool.

The first hand tools, we may suggest, are those tools which are individual tools; they can be made by one person; they can be used by one person; they develop out of locally defined materials--materials which are locally available. We may cite, for example, the primitive hand axe which is made out of local stone with a locally available wood shaft and binding, etc.--made by one man, used by one man. Then in the development you would move rather swiftly into those kinds of tools which may only be developed cooperatively; e.g., a small canoe can be made by one man, used by one man, made out of local material--a large canoe to be occupied perhaps by a dozen men may need the labor of those 12 men to actually make it, to lift it, to launch it, to operate it.

So we may differentiate between single person tools and large scale multi-person cooperative tools. And so we can quickly jump, for purposes of our present discussion, toward the very large scale tool complexes which can no longer be made and served by one man or a local group of men or with the materials available at any one local geographic location, but require for their sustenance, the availability of the resources of the entire world, e.g., like an aeroplane engine: (a) The knowledge to produce the engine really comes from the accumulated knowledge of the entire history of human knowledge, particularly mathematics and science. (b) It requires the accumulative knowledge of all men to this particular point in time to produce this kind of machine--its particular degrees of tolerance, its degrees of mathematical exactitude and processing, manufacturing, and testing of the engine. (c) It requires then in the materials to make the engine itself access to the whole range not only of common metals but of rare earths and rare metals right around the world. (d) Its service--the actual use to which it is put, in the case of the air engine--is very obviously a global one. It works most efficiently when it is actually operable around the globe, goes right around the whole of the earth.

So here's an interesting philosophical point! You go from the development of one-man tools, locally made, locally sustainable, locally usable tools, to the complex, cooperative, many-men tools which may only be produced with the accumulated knowledge of a great many men and made with the cooperative effort of many thousands of men and can only be used most efficiently in the service of the greatest number of men--which is all men. This point, is, I think, particularly missed out in standard academic analysis of technological development. Fuller is, I believe, one of the first to make this particular point in the difference in the families of tools.

A further division is into generalized tools and specialized tools. (i) Generalized tools are those which carry out the basic processes of tapping, boring, scraping, grinding, cutting, forming, and so on. These are the tools which make tools--the machine tools, which can be used either to make other machine tools or to make the specialized tools. (ii) Specialized tools--the automobile is a highly specialized 'tool' for example,--other kinds of specialized tools are tools used in a specific industry. The kinds of tooling used in the housing industry are different from the kinds of tooling used in the auto industry and from the kind of tooling used in the airplane industry. A number of such tools have much in common; others are very specialized.

We may then take this study forward to consider 'soft-ware' tools. So far we've spoken about tools, technology, industrial arts, as being something concerned very much with the physical, with the kinds of tools which make a physical impact on the environment. And here we introduce another strand, philosophically, when we speak about soft-ware, about those kinds of tools that are immaterial. Perhaps one of the best examples might be the 'word' itself. Words are typically cooperative tools from our earlier definition. They are not the sort of 'tool' that can only be used by one person. They are invented for the purpose of cooperation and may be the prime example of the first cooperative tool. The word is obviously such a tool, and is an example of one of the most powerful of our soft-ware tools. So one could take this as a beginning example of a very early soft-ware tool and come up very swiftly into the refined sets of soft-ware tools which we now have.

These are, as it were, no little less 'materially' effective than actual physical tools, e.g., in a 'control system' the actual design may only be a number of sheets of paper, perhaps a length of punched tape for a machine. This may be as physically effective as the largest piece of earth-moving equipment, in the degree to which it operates on the physical environment. Symbolic systems such as mathematics are a particular example of soft-ware tooling. The elaborate process and control systems associated with cybernetics, the whole of cybernetic theory, information theory, is in this sense the science of soft-ware tooling.

This could lead forward into consideration of the whole process of systems analysis, of the ways in which men organize themselves and knowledge together, into large scale 'soft-ware tools systems'. A bureaucracy is, in this sense, an example of soft-ware tooling. The city as a social institution, would be an example of a large scale soft-ware tool system for dealing with the environment, in much the same way that a piece of earth-moving equipment 'deals' with the environment.

Phase 4 considering such soft-ware tool systems returns us to the service industry theme. We used previously the example of the airplane--its global use, its servicing, its calling upon a very large industrial complex and the whole resources of the globe, to actually serve and sustain it in a material sense and also the immaterial sense. This would be one of the points where the strand of tool evolution in phase 3 develops into phase 4--in our particular scheme into the service industries--the analysis of the world network, service industries, telephone, airways, communications services, hotelling, even universities. These services also expand swiftly with the onset of the industrial revolution. They were in existence before that time but they take on their industrialized character after the middle of the 19th century. We could look upon the very early fueling stations of the various war fleets in the early days as an example; then the large 19th century 'global' navy is a typical example of an extended service industry for the purposes of war.

The laying down of any series of supply and service stations would be a generalized example. A transportation service industry such as the automobile, existed in primitive prototype form as stage coach stations or relay stations in the pre-industrial period. Now we have to think rather more complexly about this service as industrial network. The automobile is only a kind of moving object which is plugged into a whole network of vast and invisible sustaining services. It is useless without this vast network of roads, turnpikes, and so on. It's useless without the equally vast network of service stations along the road which serve the car as it goes along, refuel it, give it spare parts, all the kinds of energy inputs, etc., it requires for sustained use.

The airline, telephone and other network service systems may be considered in the same way. This is a very important theme to deal with, and one which is not normally conveyed, in any kind of orientation course in this area or any of the other areas of undergraduate education. The whole notion of how the particular kinds of services, networks, and industries have now developed to the global level becomes a particularly key point, in orienting the student toward the largest extent and scale of 'industrial arts' in our period.

Another important point is that the service industries are not tools in themselves. They have no purpose, no utility, other than their plug-in quality to a background service--to a largely invisible support system. The telephone is not in any real sense an 'end product', other than representing the end of a particular terminal. It is a 'contact product'--a product which you use to plug into a very much larger and quite invisible service.

Phase 5. This leads us to phase 5 in our particular program, the 'end' phase of consideration where one talks about all those products which are usually phrased as 'end products'. Our reconsideration leads one to the philosophical point that there are, in effect, no end products in the industrial process.

There is a rather complex one to get over and actually returns, in part, to phase 2--the use of materials. Most of the products which we refer to as end products, when you consider their actual use life cycle, only have a particularly limited sort of 'end' life which may only extend, say, for six months, or even for a few minutes with certain kinds of expendable products. You have a range of tools now whose 'life expectancy' or end life-use ranges from a few minutes, in the case of paper products, to about 25 years of 30 years, in the case of an ocean liner. But even the latter period is contracting as use, scrapping and recycling phases speed up.

A building might be considered as one of the longest use life tools but we now see that a building in a metropolitan center may only have a use life of 10 to 15 years. Previously, we thought about such products as relatively 'permanent'--now all of their use cycles are contracting. In effect, they represent quite temporal configurations of materials which are in this particular form and shape for a given limited period of time.

This is particularly evident in the advanced industries of airplanes and rocketry, where many of the metal alloys are so relatively precious and the amount of economy required in their use is such that they are stamped with a particular code number in manufacture to ensure scrap recovery. After the material has gone through its particular configuration, e.g., as part of an airplane, instead of just being scrapped and reselected in some relatively haphazard way, we now have quite rigorous ways of maintaining vigilance over the extraction of particular prime metal alloys just by examining the series of stamps or marks on the fragment of the engine or that aspect of the airplane or rocket.

This is particularly interesting development because it suggests other kinds of things. It suggests that where we, at the moment, concern ourselves only with the design and immediate use of the product, we are beginning to think of the whole cycle. We have not hitherto concerned ourselves with the amount of energy input necessary for dismantling of a structure for the next part of the phase as it goes into recycling. Where we are beginning to stamp metal for scrapping and careful retrieval in advanced sectors of industry, we will get to the point quite swiftly where we'll think of the design of more general product not only in terms of its manufacture and single use but also of designing how to retrieve or recycle its materials for further use.

This is not only interesting philosophically, but practically from the point of view of the actual economics and efficiency of the whole industrial process. It extends a 'design science' wholeness over what we have called the industrial arts--because designing for use, service, and then for scrapping, re-use and re-service makes the particular kind of comprehensive whole process which we were not susceptible to before.

Phase 5, then, we call the evoluting contact product--conveying the idea of there being no end products now. The best example is the telephone. Here we have a relatively invisible instrument whose physical form hardly changes for very long periods. There's no need to change the contact instrument very much in this case. In the design of the actual hand set--we seem to have arrived at a relatively stable form for that particular function. There may have been a number of variants on the hand set but the basic form hasn't changed much in the past 10 years. It's not likely to change much perhaps in the next few decades unless we come into something like the visi-phone which is an extension of the visual capacity into it, then it would obviously change.

At any rate, the telephone, relatively invisible, is only a contact instrument within an enormous industrialized technological network. We may note also that telephone technology has changed considerably and is changing quite swiftly and yet this is not reflected in the actual design of the telephone contact itself.

The same may be said of the electric light bulb. Here is a particular kind of tool which is only, literally, the plug-in tool, for access to an enormous energy system, to an enormous back-up and support system, to all the research and development in the use of energies generally, and specifically in the use of lighting energies. You could show an enormously long history of the way in which we have upped the performance of our energy conversion of electrical generation, which is not visibly reflected in 'the appearance' of the electric light itself.

Many of these points that are particularly interesting philosophically have again this reflexive action on the 'practical knowledge' side. This brings us back to the point where I suggested that the overview program, the 'knowing about', the 'intellectual knowing,' should be integral with the 'knowing how'.

Getting down to the nuts and bolts aspect of the curriculum, we have all too many studies which speak very broadly about the need to develop certain kinds of curricular studies, but too little attention has been paid perhaps to the actual way in which this might be done. We have, in relation to our particular program, developed a set of guide documents which are arranged as an actual curricular study. It should be stressed, however, that these guide texts are only outlines.

In order to communicate the kind of overview we are speaking of, in the most forceful and effective manner, one would use the fullest and most complete range of all the teaching and communication facilities. It shouldn't just be sort of a lecture course, with assignments in the usual dry academic manner, but the whole course should be planned, as a combination of lecture, discussion, seminar, film, television, and actual research exercises and live projects. Every device, every kind of direction which can add immediacy and meaning to the whole experience should be utilized. Instead of just being a course which you process the student through, this kind of overview experience should be something with which the student is engaged directly, and immediately, in exploring for himself. From the outset, the course is organized so that the student is actively engaged individually.

In designing how the student works practically, one would draw up a listing perhaps of all the kinds of tools required and by tools I don't mean simply the kind of workshop tools but all of the kinds of communication reproduction tools, e.g., microfilm, tape, film, projectors, cameras, and so on. One would also draw up a list of all the 'skill' experiences which the student would get from the course. He would not only be viewing certain kinds of films which would describe historical development or specific phases of energy conversion--but also making films. He would not only be shown how to operate a camera, for example, either still or a movie camera, but would in the normal course of his studies be using such a camera as a working tool. One doesn't think here of the very lavish use of high cost equipment but in terms of assembling complete kits for individual student use, or group use--of 8 millimeter cameras, of cheap tape recorders, of the whole range now available of small scale, individualized tools which may be deployed to amplify the energies and work of the individual. Again you notice that integral with the way of organizing our experience is a philosophical attitude toward the tool itself. We would use wherever possible, machine energies to off-load the routine function for the student from the very beginning--and we would point out that this is precisely what we are doing. That would be one strand then --the actual use of different kinds of tools to communicate the notion of industrial arts in the larger sense, and to be used effectively and directly within the program itself.

The second point may be the emphasis on the soft ware tool. What do I mean by this? I mean actual organization. What is the actual organizational "system" of the course itself? How are the students organized? Is an organization imposed upon them? Are they just a bunch of students who go through a particular course, or may we structure it some other way around? May we structure the course itself as an actual organization experience--that is, train the students in organizing themselves in relation to the course work? We may call upon them to address various questions. How do you organize yourself as a kind of learning apparatus? How do you learn how to learn? What are all the kinds of study skills that you need to acquire? What are all the kinds of technology that you need to master? Then to group organization; certain of the projects that are undertaken may require that the person work within a group. It seems very simple. You may say it's hardly worth talking about those kinds of things because people learn this naturally. I don't think they do. Generally in our educational system we subject the student, in his undergraduate years, to four years of quite rigorous individualistic training where he is competing, in a sense, with others--competing against others to get the highest grade, or to get above the class average, etc.; and he is examined as an individual, on his own individual attainment. We stress this paradoxically within a context in which we refer constantly to cumulative cooperative endeavor--about the importance of the cumulative nature of science, of the importance of the cooperative nature of technology. This is very interesting! The way in which the 'study experience' is conducted is quite different from the nature of the experience we wish to convey.

I would suggest, therefore, paying a great deal of attention to the different kinds of social organization which might be employed by the student, and used as a deliberate training mode while he's going through your course.

He and his fellows might design different kinds of organizations to carry out specific tasks. I'm thinking here of the many different kinds of organizations required for different kinds of tasks. One could go from the simplest one--organizing yourselves for a particular kind of audio-visual presentation, with the allocation of particular tasks, like who's going to run the projector, who's going to provide the spoken commentary, who's going to select the images, and so on. These might call for the allocation of individual functions within a group.

Another example might be where they are actually making a field trip to a particular kind of factory installation or a particular kind of technological installation. How do they divide up the functions, say, for observing and recording that particular sort of experience? The other might be a research group where you're going to examine, perhaps, the development of communications technologies. How will we dispose of our individual talents in the work group situation? Do we switch them around, for example? Does a person spend only one week maybe, or two weeks, gathering a particular kind of data and tabulating that while the other person is synthesizing that data with other data inputs in the other part of the group? Do we switch around those functions so that each person has an equal kind of experience?

The leadership function--how is this disposed of? Do we elect our leaders, do we arrive at leadership in terms of expertise? You see what I'm driving at. By using this kind of organizational experience you can also communicate, within your industrial arts program, the whole notion of how men have organized themselves in different kinds of social structures, different kinds of organizational formats to carry out different kinds of tasks.

This can, at the one point, be small-scale group projects or it can lead up to the very large kind of full scale learning system where you might use the entire student year for a particular kind of function, for a particular kind of research strand--where all the inputs from different groups on one particular line may feed into one large inquiry which may then (the whole result of that student year) be presented to the whole school in some kind of exercise, either as a television program, or as a series of films, or as some kind of presentational exhibition.

This gets one out very quickly toward the ways of engaging the students directly with large scale systems analysis and systems organization. It gets it out to the point where he's not just being told about this area in a lecture, or going through it in a textbook, but actually where he engages within the process so that it is a meaningful experience to him. You can 'simulate', in the course structure, all of the kinds of organization that he should know about, as existing in the whole of the industrial complex. I think that this is a very important function, of 'simulating', not only in the classroom experience but in the whole of the educational experience. Unfortunately most simulation has gone over into simulating very specific functions but I think the whole educational function can be informed by this method. Many studies can be based on paradigms or simulations of larger scale external processes--so that the learning experience is more immediate and dynamic.

The point to be stressed is that the 'knowing what' or the 'awareness', goes hand in hand always with the 'knowing how'. The actual detailing of this, in our presently brief outline is not practical. If you look at the volumes that we have prepared for our program, you will see that they are an example of what I'm talking about. You should look at them as the skeleton of a series of case studies which may actually be undertaken by students.

In volume 4 you will find such a case study called the geoscope. In Phase 1 of our program we called for 'world literacy tools', and set architects and planners the task of designing new kinds of educational tools. In this case it was called the geoscope--a large mechanized display system for displaying world problems.

Wherever this has been tackled, it has engaged a group of students, often over a period of 1 to 2 years with a very complex project involving not only 'knowing what' but also of 'knowing how'. Not only did they have to gather the data, the knowledge, the information, to put on display about world problems and their technological solution, but they also had to acquaint themselves with the kinds of technologies necessary to develop the tool to its prototype form.

I have myself run projects of this nature where we completed, within a given period, a full scale working prototype, made within school workshop facilities but also calling upon all the other ancillary technologies in the community or local industrial complex. The way in which we organized ourselves to carry out the task was in itself a paradigm, a simulation, or a research and development group which had charged itself with the development of this kind of tool.

This is very interesting kind of experience because you are developing, in miniature, the simulation of a very large scale program--such as say the design and launching of a rocket, and you can use very much the same kinds of techniques within the group. The techniques of systems analysis are 'naturally' engaged with analyzing the entire system in terms of human energy inputs of the desirable outcomes of certain kinds of procedures, sorting out their contingencies, checking out the whole timetable, or in 'pert-scheduling' the whole operation through, from beginning to end.

This I think bears looking at very carefully as a model of how one may get this close relationship of knowledge and practice--of getting a completely different twist to the educational system than we have at this particular point--of getting away from the dry routine of lectures, assignments, reading courses, studies, examinations, etc. When you get out to the point of 'examination', the examination itself may be integral with the learning process, e.g., does the prototype they've designed work?

I have often used this method. If a student was interested in transportation and he and his group were working on the design of a ground effects vehicle, then the end examination was that this ground effects vehicle, which they put together, using their own workshop and local industry, actually operated. 'Passing' of the course meant that the instructor could get on the machine and ride for 100 yards. This is a very real kind of test. The student can see the sense of it--he can see it in terms of immediacy and practicality.

In retrospect, there may be an emphasis in my notes which seems to confine industrial arts to aspects of industrial production. I would prefer to emphasize, at the end of this presentation, that one should consider the widest possible range of technologies. Where I have spoken, say, about a ground-effects car or about a geoscope, these are only examples.

I would like to emphasize the whole range and diversity of approaches possible, e.g., in the study of communications technology, watching, analyzing, comparing television programs may be as effective a way of study as many others. This may be related practically with the design and production of a television program or a film. You may say this is beyond the capacity of a school and, indeed, perhaps beyond the capacities of the students. This is not quite so. As above, I think we often neglect the point where we may undertake very real and very practical and very exciting simulations of these things. Where we cannot lay on the actual facilities of a television studio, we can very easily simulate them.

You will notice that the process of simulating requires the same kind of thinking, the same kind of scheduling, as if you were working 'for real' with a full range of equipment. A very interesting case for this was made some years ago when a consultant to the government of India was asked about their problem of getting into very large scale and costly computer installations, of engaging with cybernetics. He suggested that one of the best things for them to do was to proceed as if they had the largest and most efficient computer in the world. In effect, the discipline, the rigor, necessary to frame their problem so that it could be processed by the largest and most efficient computer would be 90% of the task. So they didn't actually need the computers immediately--not in the intellectual sense. The computer might exist for the moment as a kind of stimulus towards which they would direct the requisite amount of thinking, the requisite "knowing-what," and "knowing-how," before they actually got to physically dealing with the computer. In effect, by stating their problems adequately, they would have gone 85 or 90% toward solving them. And I think this kind of imaginative thinking should be pursued--throughout the type of program we are discussing.

When I suggest this kind of approach, I don't think it should be restricted wholely to the design of the curriculum. I am always interested, 'reflexively', in returning the whole process back onto the student. I should think that from the outset again one has to engage the student in all such innovative procedures, in the innovative creation of the curriculum.

The curriculum itself should always be constantly self-generating. It should build upon the creativity of the student who should be actively encouraged to modify, to extend, to expand, to transform the curriculum itself. This constant kind of feedback should always be on-going.

If the demonstration of physically constructed devices, or the presentation of results is going to be one of the 'end points' of study rather than the usual examination on a series of test questions, then, automatically, this involves this kind of response. Ongoing critical assessment of the program itself is a means of testing its effectiveness much more than any 'set', oral or written examination.

DAWSON: You can see that at this very early point in the program we are already one program behind. I think what we should do, Paul, is spend just a few minutes discussing this presentation before it loses its freshness. Not in the light of what we want to say to the University but to make sure that we understand the ideas as presented. Then I would suggest we spend the rest of this morning in one session rather than two sessions as is identified on our schedule. Rather than discussing definitions or objectives of industrial arts, let us clarify any points or criticisms we have of this presentation and then we'll come back and give ourselves a challenge to carry on more specifically with suggestions for the University.

ALLISON: It certainly was an impressive presentation. What I shall say certainly is not meant as criticism. I want to provoke conversation. I wish Dr. McHale had talked a little about an important ingredient in any program of industrial arts: we might call it "the dangers of technology." This conference should discuss this, along with the powers of technology and the natural extension of evolution. I say this because I don't think this is, in nature's guise, a natural extension at all. It's perhaps an intellectual extension of man's capability. But a program of industrial arts education has the responsibility to educate the informed citizen as well as the person who will perform in the industrial arts.

DAWSON: Thank you, David. Edward?

HASKELL: I find this presentation of Dr. McHale's extremely broad and profound. It alone has made it worth my while to come to this conference. I should like to point out one thing, however. He mentions, in summary, what he calls the geoscope, a tool for displaying world technological problems. No mention is made of world political problems. Who determines who gets to make and use the geoscope? Dr. McHale is describing not the training of philosopher kings but of their commissioners of technology. Now this is extremely important in view of the following. The training of philosopher kings is going on in the USSR, not in the USA. And I say this advisedly. Last week at a meeting of the Society for General Systems Research in New York, Dr. Titus Podea and Dr. Alice Mary Hilton described the Soviet Union and the schools which are being conducted. And this is--in the words of the Soviet commissioners of education, not ours--for the training of philosopher kings. This of course is an ancient term--Plato's term. They don't mean it in the sense of hereditary leadership. What they do mean is this: from the 12th day after birth they are testing hundreds and hundreds of babies. From these they are selecting the most promising and gifted. They are putting these in schools, where one child is taught by one teacher. The teacher-child ratio is one to one. And is called the psycho-cybernetic school. They go there, I understand, at about the age of 3 or less. After a while, a year or two, the ratio becomes 3 students to 1 teacher. And they bring in, constantly, specialists. What they are training is not merely people who will know the technological problems and the ways in which to elaborate these great service systems, and this sort of thing, but how to rule--how to train people to cooperate or, on the other hand, to train them to struggle and fight and disrupt. How to rule--this is a technology. It is a very complex and a very important one. And I would like, later on perhaps, when I have an opportunity to speak, to show how these two things really go together and how it is disastrous that we confine ourselves to the training of commissioners of technology.

DAWSON: Thank you very much, Mr. Haskell. Anyone else want to comment on this presentation?

MULLER-THYM: I have two or three reactions. I share the view of the two previous speakers on the power and vision there is behind what Dr. McHale has just presented. And I have no quarrel with any specific thing. It seems to me that if he views this as an extension of the evolutionary process. He talks about development of the geosphere. In the same way that economics and politics become an extension of man, he is talking of the whole order of being brought into existence by technology as one part of the geosphere. In that sense

I think I could accept what he is saying. There is the assumption, never stated, that is a practical part of this conference. Is the assumption that industrial arts education is concerned with the teaching of teachers who function in our industrial establishment at some secondary school level, and the assumption that says the education of those students will not be cut off once they graduate from what we call high school; that they may conceivably go on to some kind of college education? Is it assumed that industrial arts education is a part of a larger system of education in which education and communication as an interior intellectual experience, in which the knowledge of history, and education in the sciences, not only the classic physics which are paralleled by the cultural assumptions of classic economics, is considered important. Adam Smith and Carl Morris both cling to the theory called thermodynamics. And in fact economists have never broken out of this track. But the world of Galileo and Newton, which is not really in our world, is still useful in understanding the technologies by which we have made things, in which up to now we have employed their assumptions. We are just now changing; we are at the point of change. I think the paper has given the background to an assumption that the same school in which there is a new approach to the industrial arts curriculum, there would also be corresponding changes in the way the sciences are taught, the way they teach the things people group under the heading of humanities, and the way we teach history. Even though Dr. McHale doesn't say this, there would have to be that kind of interaction. The third, in this presentation of a spectrum, of the development of the works of man, the development of the extensions of man, makes no mention of the absolute discontinuity with which we are presently faced. This is very much like the discontinuity that at the moment was faced when man passed from a nomadic existence, living in an oral society, a society that had no history, no sciences, arts, or technologies, but had only the knife and the lever and some fire, to a society in which man excelled on the land, invented ownership, invented the household, invented work, invented the wheel, and invented the technology of decoding information with the use of the phonetic alphabet, rather than heliographs or some other type technology. The industrial revolution really was when the cause at stake was able to be captured and applied. The basic work unit which was the household was removed from the cottage into the long house. It was then we started to organize work we have since described as "the pin factory". They didn't do anything more significant than that. It was nothing like what we are going through today, where there is this absolute discontinuity. We are moving into the electronic world. The whole process changes, in complexity, in the way everything in our society is affected. Today is paralleled only by the other set of changes we went through about 3500 or 4000 B.C., when we invented all the technologies and ways of doing things which are now either in the institutions which are now either absolutely disappearing or changing their character so radically as to be discontinuous with their antecedents. And McHale comes right up to this point but he doesn't say a single thing about it, in this particular talk, about what there is on the other side of the change in which we are all now, irreversibly, involved.

I would think in an industrial arts curriculum, in which one is going to teach people how to understand and be an intellectual individual, about their environment, about their activities and about the works of man, that you could conceivably afford *not* to try to point out to the people the kinds of changes that will bring into existence the very world in which they are going to live.

DAWSON: I don't believe Dr. McHale believes this and probably didn't really allude to it. It seems to me that we are in danger of forgetting the most important objective of education and that is to help people learn how to go on learning the rest of their lives. Dr. McHale did say that. But almost all the rest of his presentation was on the idea of the areas about which you learn and not the learning process. It seems to me that industrial arts people have been more concerned with tools and materials and processes, than the ideas that spark the tools and materials and processes. We are going to have to get into this area of conception not only of the conceptual approach to content, but the ideas which spawn technology. Now if we can ever get our industrial arts people thinking in this direction, I believe we will overcome a lot of traditionalism concerning tools, materials, products and processes. The second concern I have about the presentation is we seem to be more concerned with the technology itself than we are with the people who use the technology or who masters the technology. I don't believe we're getting to the point where technology is going to control the people; I think we are going to control technology. But it seems to me we need to be more interested in the educational process--more interested with people than we are with the material about which we're talking.

ALLISON: As you were talking and as I was listening to Dr. McHale, it occurred to me that there is a parallel here between industrial arts, and its problems over the years, and engineering and its problems over the years. The engineering profession is trying to work itself out of a 19th century tradition, when the need was to provide the country with engineers. Industrial arts, I learned last night, performed this same function in the 19th century. But in continuing on that same track, the engineering profession has got itself hooked because it too must now come back to basic science, to fundamental things, if it is to provide the tools which engineers can use. I heard a story the other day which illustrates this problem in engineering. I think it translates into the industrial arts. The story concerns a distinguished engineer and educator named Clifford Furnas, of the University of Buffalo. About 30 years ago, when he was a young engineer, Dr. Furnas was asked to write a paper for one of the journals in which he would forecast the changes that were going to happen in science and technology during the next 100 years. He wrote the paper and it was published. He had occasion, 30 years after he had written it, to read the paper again. To his amazement, he discovered that all the things he had said would happen, a hundred years from now, had already happened. I think this is a stumbling block that most of us are apt to encounter and stumble over. We perhaps know too much about the frontier of our field to be able to see far enough ahead to be reasonable predictors of what will be the need, what will happen, at some point in the far future.

MICHEELS: I'd like to underline what Dave has said. I think this is a very interesting observation, and it might be very good to reiterate it for some industrial arts people. By underlining it in this sense, I daresay that twenty-five or thirty years ago in this university and most universities the engineers and industrial arts teachers were in the same laboratories together.

DAWSON: It wasn't that long, Bud--I was!

MICHEELS: This is true. So was I. However, the engineering curriculum model has changed so that today we have engineering science with a very minimum of traditional laboratory work. Many predicted they would have difficulty once they got rid of these experiences.

In a sense they had. But what they were trying to turn out was an engineering scientist, not an engineering individual using science in the sense of a practitioner.

SINCLAIR: This is the abstract intellectualism that Julius Stratton had spoken about.

DRAKE: I'd like to interject something at this point. It's personal in a way but I think it relates to the question of technology and man. My background is in operations research and I've been trying recently to apply it to public sector problems. When I was a graduate student my specialty was in mathematics and economics. As I was working on my dissertation I decided I would do it in the area of competitive bidding strategies. What I did was to select an industry and to attempt to describe the industry mathematically. I built a model of it and the competitive environment in which it existed. Then I selected a firm within that industry and figured out if there was some way the firm could be modeled with respect to the industry so that profits could be maximized. This is an acceptable operations research dissertation. Right about that time I became interested in applying this technology to public systems such as hospitals, school systems and local governments. But at that time I was already committed to trying to apply systems analysis to societal problems.

I came up with a model that worked pretty well. I determined an analytic solution as opposed to a simulated solution. Everything worked out quite well. I applied it to an industry. The profits of the two firms I applied it to, in a real situation, were quadrupled over a one year period. In a post-analysis it was found that the way in which these firms maximized their profits, using this fairly sophisticated model, was to adjust the prices of their products on the basis of the model information that the buyer had. In other words, if there was a poorly informed buyer, you jacked up the price because he was poorly informed. It's the old classical economics, if there's not free information you can make more money. However, the problem was that the people who were most poorly informed were precisely those people who could least afford to be charged a high price. They were the ones that were really penalized by this model. My point is that I was committed to trying to do some good with this technology. I had actually done it. Yet without knowing it until after the fact, I had applied this technology in a socially undesirable way.

Now I don't think that's atypical. I think it's much more typical than would be visible. Since that time I've tried, in the area of the consumer field, to twist it around. If poorly informed consumers need more information, let's figure out ways to give them information. Let's develop ways in which information can be disseminated to consumers, particularly low income consumers, with the use of a computer and all kinds of profile determinants. The point is, no matter how committed I was emotionally to applying it properly, it turned out to be improperly applied, at least in some areas. This worries me a great deal. It seems to me that we know too well how to do things. We are learning at a very rapid rate how to do things and not fast enough what to do or why we do it. In regard to industrial arts, it seems to me our primary focus should be in the process of learning, not so much or at least not only how to do things but why do them. How does society or a sub-set of society go about determining what it wants and manifesting it in some visible form?

HASKELL: Dr. Dawson, you made a comment about Dr. McHale's talk, namely, that you felt he had not sufficiently discussed or emphasized methods of teaching.

DAWSON: I wasn't so concerned, Ed, with the methods of teaching as I am with people--that we don't divorce people from the technology. The two I think have to go hand in hand. Let us maintain the idea that industrial arts deals with people, with young people, and let's don't forget that idea--that's the point I wanted to make.

HASKELL: I just wanted to point out that what McHale really was doing, I don't think was so much talking simply about industrial arts or young people, about the training of high-powered rulers, future determiners of technological operations and education. One thing that I found very interesting was that he spoke of simulation of the kind of things the people would later be entrusted with professionally. This I think is of extreme importance. I'm going to try it in the course I'm going to be teaching at the New School for Social Research, next spring. It's a course called Assembly of the Sciences--physical, biological, psycho-social-political. And in it I'm going to try to simulate the kind of inter-faculty committee which could bring about the transformation of a university by the methods developed by our Council for Unified Research and Education.

That's a simulation and it's an application, I think, of the kind of thing which Dr. McHale has advocated. And I know that everyone here very much agrees with that sort of thing.

It seems to me that what Dr. Drake has just said is another case of experimentation. In his dissertation he showed how you can maximize profits, at certain levels. This was applied to his dismay. In this experiment he discovered that side effects, not anticipated, were produced. He then immediately began working on a method for correcting these side effects through consumers research and consumer education. So we have in a very brief span of a very few years, you might say, a simulation; but in real life: a very rapid experimentation and correction of an unexpected side effect. The thing which determined Dr. Drake's course of action was his own internal values, his feeling that the weak should not be further exploited, and further trampled upon and destroyed. He believed they should be cooperated with, helped, as well as helping the strong. So it seems to me that values did underline this whole thing. And I shall try, later this evening, to show how values can be incorporated; and in fact, are inherent in any synthesis or any unification of science.

DAWSON: I appreciated very much the statement that Dr. McHale made suggesting a simulation of the whole educational function. This is exceedingly important for industrial arts and for all curricula which might be involved in an interdisciplinary approach to education.

DRAKE: I want to make a comment on the use of the term simulation and mathematical modelling. I view systems analysis, operations research, and the computer not as radical innovations but rather evolutionary. I've been developing and using the systems approach for about 10 years now and have tried to apply it in quite a few different areas. I guess I feel that in many ways it's been oversold. All of us are striving for an understanding of a set of phenomena that is tremendously complex, namely, society. Systems analysis and some of the other new technologies appear to be a solution. I tend to take the view that it is an incremental process in which we are inching toward a better capability. We can now extend the number of factors we are studying at any one time, and still keep the problem analysis manageable. Oftentimes attempts are made to go a bit too far in being all-encompassing, with the result that the problem analysis becomes unmanageable, given the current state of our intellectual art.

DE VORE: The question becomes more and more complex. You have so much time in education; it's limited. We have so many resources and ordinary teachers with ordinary pupils. You come up against the question, if you're dealing with knowledge itself; what knowledge is of the most worth? It seems to me we also have a dichtomy in society today. In terms of this we have a group, such as yourselves, well informed about these problems. You recognize them and can deal with them. Then we have a great mass of people who go through our public schools that never hear the terms like systems analysis, let alone understand them or attempt to work with them. All of us, I think, recognize the tremendous benefits that are accruing to man, via his innovations and inventions in technology, together with the problems, yet what we do with this intellectual ability that we have today along with the tool resources and energy resources that McHale discusses. This is a value question. This comes back to the point I attempted to make previously. We need to find meaning, which is a value judgment, and a direction which will indicate what should be taught. Then I think we should deal with process which is McHale's concern. We are too. Someone mentioned earlier that the program of industrial arts education has the responsibility of educating the informed citizen. It seems that must occur at a given level before a person can utilize information as an informed consumer. This comes around to the dichtomy that we were dealing with last night--the essentialist which is concerned with the body of knowledge and the existentialist which is concerned, Ken, with the process--the ways of dealing with this material. Dr. Brennan and I have laid it out like this. We are concerned with identifying the body of content, or structure, whatever it might be. McHale has alluded to some of the 4 or 5 areas of technology this morning. He also discussed a classificiation system in the technologies, a taxonomy in our terms. From this we'd like to pull out what is essential, what could be identified but we'd like also to mix this with the process of dealing with these problems. What are the intellectual processes? What are the practical aspects of handling this material? How do you teach this? If a person could learn to deal with problems in the many contexts, we may have an opportunity to provide an informed citizen. We are more concerned with the "informed citizen" aspect than we are with the vocational aspect which McHale also gave a short shift to. He said this had a limited element, a limited aspect. The person with well developed intellectual processes, with a background which enables him to draw upon knowledge and deal with problems is vital.

DRAKE: I would like to introduce something else that we have not yet talked about. And that is the notion of change in society. It seems to me that every recent study that I've seen about the life history of vocations indicates that now, as opposed to 10 years ago, the life of an average vocation is between a half and a quarter of its previous one. The average participant that is entering the industrial world 10 years from now will probably have to be retrained between 4 and 6 times during his work life, if he is going to remain a viable, productive, worker in industry. The notion of change and the resulting need to build in the adaptability and flexibility of individuals is something we ought to discuss further.

DAWSON: All right. Dr. DeVore?

DE VORE: To me this is an essential point. Recently I talked to Ed's friend at Yale, Harold Cassidy. I told him I thought our job was to develop a curriculum structure and all it implies, which is externally stable and internally flexible and adaptable to change. I said most people say that's impossible. Cassidy has been working on the unification and synthesis of knowledge. He told me he didn't think the statement was impossible from his point of view. But the notion of change, this adaptability to change, this experience with the problems of change, seems to me an essential ingredient, particularly as it relates to the technologies. Maybe not so in teaching 18th century history but certainly in this field that has given us so much of the cause and direction.

MICHEELS: The place we ought to start is college and university faculties.

DAWSON: Before we recess for a few minutes may I call your attention to a display which Mr. Haskell has arranged in the rear of the room. I don't know whether it's exciting, or disturbing or what it is. Mr. Haskell, would you tell us about the display?

HASKELL: The display consists of figures that go with the paper Dr. DeVore sent out--"Specialization in Synthesis." They are not entirely finished, especially the later ones; but they are sufficiently finished so the idea gets across, I think, with a little effort. I'll be using them in a discussion this evening, so I thought it would be very helpful if you would look them over so you have a clearer idea of the kind of thing I'm discussing. My slides, unfortunately, are made of an earlier generation. One reason for the particular form that this has is that we hope to make moving diagrams for movies and television, later on. They've been done by Sherman Price, head of Multicom Corporation in New York, with that in view.

DAWSON: Very good. Thank you. We're looking forward to hearing from you. I think we'd better do a little more homework before this evening. We could spend two weeks, as I said to Tom Brennan a while ago, before we could really come to grips with the type of things that may need to be done here. This afternoon we will divide ourselves into two groups. You will discuss 3 topics, presented under Background Data, as listed on the agenda. There will be recording machines at each table. You will not have to worry too much about taking down information as presented. However, we would like to ask each chairman to select someone to hand to me, after your work is over, the basic ideas set down so that we can bring them together for a summary tomorrow before we dismiss. Dr. Micheels and Dr. Drake will be the chairmen of the groups.

I want to call your attention 3 items--A, B, and C, and then to the other items as well. They will serve as a foundation for our continuing discussion. Now to call our attention again to the specific objectives that we want to discuss the rest of this morning and then divide ourselves this afternoon. Number 1. Determine the function of a state university, in relation to industrial arts teacher education, with specific attention to these three topics: (1) the educational needs of individuals. (2) The knowledge or content reservoir and structure from which a curriculum operates. What is the domain of industrial arts or technology? (3) The characteristics and competencies of the individual who would serve as a teacher and resource person in his area of specialty. What are the characteristics of a person who should be teaching industrial arts?

A secondary set of objectives for consideration might include: recommendations and suggestions in terms of future research endeavors; major elements of the problems; methods or procedures for attacking each problem; resource personnel capable of contributing to specific areas of each problem.

The objectives of education have been set down in many ways by various studies over the past 60 or 70 years. I suppose the most recent are the four objectives of: self-realization, economic efficiency, civic responsibility, and human development.

SINCLAIR: Could you say those again?

DAWSON: All right. I won't say them in the same order--civic responsibility, economic efficiency, self-realization, and human development. There's no rank order to these. I don't think we have to rework the objectives of education, necessarily. Probably we can accept these or any other body of objectives.

MICHEELS: I think a later one, though, Ken (to interject a thought here from the Educational Policies Commission) is a single one--develop the rational powers of man. The four you list are from a previous list, from the Educational Policies Commission.

DAWSON: What better single objective could you have than to develop the rational powers of man? But still we need to break this down, I think, as well as the other ones if we want to develop principles of education into more concrete goals for industrial arts.

MULLER-THYM: Are we not then proposing any vocational bias to the program at all in terms of specific bodies of skills? Except that going through these objectives you have in mind, the student would come out very prepared to survive in an industrial world and to learn how to plug himself into whatever the current processes may be.

DAWSON: I would think that we should pre-suppose that.

DE VORE: That's a good statement of what Tom and I have been discussing in terms of adaptability to change. We have rejected a narrow vocational function.

MULLER-THYM: I think, if I may interject, the real problem of the unemployed Negroes in Chicago (for three generations now they've been on relief) is not that they couldn't be trained to do the kinds of things others do--in weeks, or months--that's not it at all. It is that their mode of life has not taught them to do the things others have now learned how to do in our society, to plug ourselves into each other. Or to speak certain languages. Because they don't speak not only acceptable English, they don't speak the language of interactions in a business world, or an office or a factory. This automatically makes them unemployable.

DE VORE: Yes. I would like to interject here, Ken, a statement made by Marshall Schmitt in his study. He indicates and believes one of the major objectives of industrial arts, which is rather vague when you consider it, but it's very specific also in terms of some of the things we've been discussing and that is, technological literacy. You have humanistic literacy which is concerned with value judgments and scientific literacy. Technological literacy involves the language of technology; the communications of technology; and the problems and the ways of dealing with this. This is the literacy with which industrial arts is concerned.

MULLER-THYM: In reference to the literacy question, we need to address ourselves to the real world. What is happening in our world? Not only is there more "think" type work going on, but think type people as a percentage of the work force are increasing. The intelligence of man is increasing and causing competence to flow and interact. This is a completely different set of work requirements and structural requirements for the design of competence flow. To learn how to do that is one of the skills we've been building up since about 1950. It is not just a matter of literacy. It's a matter of knowing--somehow feeling an awareness of the knowledge of how, in action, one puts himself into intelligence flow or a component of it.

DAWSON: I think we should assume here that industrial arts was spawned as general education as opposed to specialized education or occupational education. We have said it but we have not practiced it, and the field is very split. Even though most industrial arts people will call themselves general educators and express concern for technological literacy, they are still prone to move in the direction of preparing people for a manipulative skilled approach to a job. We have said one thing; we have done another. And I think we should not pre-suppose that industrial arts has a vocational connotation at this point.

__HASKELL:__ The question of the individual and his needs seems to me very relevant here. Because I, as an individual in school, was constantly frustrated by the way in which education was conducted even some of the best schools. My own college was Oberlin. I felt that my professors didn't know each other's disciplines. One professor would say that hair color, eye color, and odds and ends like that are genetically inherited. I'd tell this to the genetics professor and he'd walk up and down the room exclaiming, "Odds and ends, odds and ends!" Then he'd say that everything is determined genetically with only slight variations inserted into that by the environment. And so it went, from one to the other. This is what made me so frustrated that I decided that I was not going to take a Ph.D. and was not going to be a teacher in any of the departments because it did not seem to me they could make it possible for me to understand the world or to function in it as I ought to. The riots in schools now are being produced by young people who have some of these same feelings. When I later taught at Brooklyn College, some students in my classes formed the Systematic Social Science Club. They soon found themselves pitted against the Marxist Club. The Marxist Club was composed of the kind of students who are now rioting and organizing the riots. That is, they were simply fed up with the way the college was teaching them. There was no integration of knowledge or our view of the world. Many of these students found this integration only in Marxism and Leninism. And this was filling the vacuum which was being left by our over-departmented, one-field specializations. So it seems to me that fulfilling the needs of these sensitive individuals who often, at great risks to their futures, expose themselves to future blackballing, if not, in fact, inprisonment and later on concentration camps and so forth is of very great importance. There is, I think, in this new process, which you are now considering, the answer to the dilemma which is forcing these young people into these violent--and not altogether irrational--actions. I find, much as I hate to think it, that they are allies of mine simply because they are forcing the authorities of the universities and the colleges to pay attention to the difficulties into which education has evolved; and to pay at least some attention to reorganizing and reformulating it.

DE VORE: May I raise a question? We have been working on the problem only since September. We have been reading, thinking, and discussing the issues. We have tried to come to some tentative conclusions. We have a job to do and certain conclusions must be reached at various stages in time to move ahead. As we look at this problem as we reflect on what has been said in addition to our correspondence, one conclusion is that the program for the preparation of this new type of industrial arts teacher must be interdisciplinary. It must integrate many parts in order to deal with values, with knowing, doing, knowing that, knowing how, as described by Jarvie in his philosophical construct of the structure of technology. Would you see this as a conclusion we can stand on at this point in time? Do you see a program that must involve and cross across all university disciplines to give the new industrial arts teacher this kind of background?

MULLER-THYM: I don't know how you're going to do it, but sure.

DRAKE: I have some observations on that topic when we get down to the nuts and bolts. It is something which I have been deeply involved in at Michigan; namely, forming a program that cuts across disciplinary boundaries. I have a "model" of what works and what doesn't work. It's a very black and white model, but maybe this isn't the nuts and bolts time.

DE VORE: Why don't you give us a sample of your model?

DRAKE: Sure, if this is the time. First of all, one of the most effective change agents at a good university is the students. If you can get the best students in individual disciplines to exert pressure on their faculty for the opportunity to cross disciplinary boundaries, you have a significant lever. A professor's life blood, I think, rests in his highest quality graduate students. And if the professor sees his best students unhappy, then he will try to respond to that problem. Another component of my "model" concerns the method of development. No interdisciplinary program, in my opinion, can be imposed from the administrative level within a university. It must come from the individual faculty within the individual departments from the beginning: not half-way, a quarter of the way, or a tenth of the way--from the beginning of the effort. Finally, there can be no dominate figure in the group. A studied effort must be made to insure that there is no such individual. In other words, if you're talking about a program encompassing psychology, economics, political science, and engineering, you make sure that if the psychologist starts exerting himself, there is a mechanism for self correcting the group's balance. Those are 3 aspects of my model for formulating a viable interdisciplinary program. It doesn't insure success. It is just three necessary conditions; by no means are they sufficient.

SINCLAIR: In terms of your model alone, would the fourth condition be that there must be some viable economic opportunity within the college for graduates of this kind of program?

DRAKE: I don't know. In the program forming at Michigan, the graduates are going to be mavericks. I'm not sure who's going to employ them. I suspect they will create their own organizations or subgroups.

SINCLAIR: Within an academic field?

DRAKE: Hopefully not exclusively in an academic community. One focus of the program is acquiring analytic capabilities. By that I mean strong analytic capabilities, broadly conceived, not just math, statistics and operations research. The other focus I hope will center on the processes of innovation and intervention in societal problems.

MICHEELS: I highly agree with you on your first presupposition that this cannot be dictated by administration. But it seems to me the fourth point is that there must be support, whole support, from the administration for this interdisciplinary program. And I can use an example of my own for that reasoning. Back at the University of Minnesota I attempted to set up a core for the preparation of teachers. It so happened that I was gone for two years and came back and tried to implement it. A core in mathematics, science and technology as an interdisciplinary approach for the preparing of teachers. A quick simple example. I was thinking about leaving and the Dean took me over to the President and we were talking about it. He said, "My heavens, you want another way to teach math? Here we've had two departments in math--engineering and liberal studies--and trying to get one, and you want to add a third one!" Right away I knew I was leaving Minnesota. This would lead me to say there has to be administrative support, both in dollars and cents and in terms of other resources. Are you assuming that?

DRAKE: Not necessarily, but it certainly helps. I guess a fifth factor that I would add is the current need for faculty to identify with his original discipline. For instance, I don't believe that the University of Michigan could obtain a good young urban economist unless he was a fully accepted person by the economics department at Michigan. He would demand, as part of his acceptance of any offer from Michigan, an appointment in the department of economics. He wants to be first an economist and second an urban or regional economist. Now someday maybe this will be unnecessary. Now, and in the foreseeable future, it is a rare person who will risk deviating too far from his "parent" discipline.

MICHEELS: He has to have this one foot in essentialist and one foot in existentialist pastures.

DRAKE: Right!

HASKELL: What Dr. Drake has said is highly relevant to what our Council for Unified Research in Education has been experiencing. Our members each belong to a different discipline and none has dominated except for one thing. The most abstract, namely mathematics, has been the organizing factor of them all. This was predicted by Leibniz who held that one day it would be discovered that separately developed disciplines had certain structures in common. That the data displaying these common structures would be gathered together in what he called the "Demonstrative Encyclopedia." Then, he said, from this would be abstracted that structure which all of them had in common. This he called the "Universal Characteristic." He said this would be, probably, a kind of geometry. Well this is what appears to have happened now. The relationship seems to be the structure of the geometry--it's a paradigm: the class of structures of which all the empirical sciences, their paradigms, are cases. Only in this way, apparently, is it possible to bring them together in a single discipline. But it's always the most abstract thinkers--those who understand, know, have had lab experience in, and have studied the disciplines of the special one-field sciences--who seem to be able to bring them together. There isn't any attempt or possibility of eliminating these one-field disciplines. They are essential and will continue. The hope and objective is to have them so structured that each can understand the other in terms of this meta language, or what we call the paradigm.

DAWSON: It is time for lunch. I'd like to raise one point, however, before we go. We are not sure we're getting the most out of your good minds while we're here. Does anyone have an idea how we could make any improvements in the direction we are going at this point? I think, Bernie, you may have had a comment during the break. Did you want to say something about the direction or how to attack these problems?

MULLER-THYM: Not at the moment.

DAWSON: Let's hope we are going in the right direction. After lunch, we will meet in our respective groups. Please meet promptly at 1:30.

MICHEELS: What does group 1 do and what does group 2 do?

DAWSON: Let's identify our purposes. I would encourage you to spend no more than the first 45 minutes or so on A, educational needs. Spend the first third of the period on A and the rest of the time you may need on B.

Thursday Afternoon
November 9, 1967
Group 1 - Discussion Session
Dr. Micheels, Chairman

MICHEELS: This is group 1 of the afternoon discussion session. I'm Bud Micheels.

HASKELL: I'm Ed Haskell.

SINCLAIR: And I'm Bruce Sinclair.

MICHEELS: I think as we start to determine the functions of a state university in relation to industrial arts teacher education, our first assignment is to consider the educational needs of individuals and society in terms of those areas of present or future influence to which industrial arts could or should contribute. This will be a free discussion. Should we start out in a broad sense in terms of the educational needs of individuals? I suppose it logically leads into what are the needs with respect to industrial arts. Could we agree with the Educational Policies Commission that the central purpose of education is to develop the rational powers of the individual? This is not the only purpose, nor is it the sole purpose but it is the basic and major purpose of education. Would you agree?

HASKELL: Yes I would agree except that I would point out something that I'm sure everybody knows and agrees with. In our society, first of all, there are many different ethnic groups, there are different racial groups, and there are different social strata. Thus the needs of the individual are by no means uniform, and it is often a tragedy when one educates an individual for just the needs all of them have in common, teach everyone the vague general thing that the whole society can conform to. Actually many times in his life, or her life, it's a very much more limited, parochial special kind of education that would meet that individual's need.

MICHEELS: Might that--much faster than I'd hoped--lead to a generalization that we can report tomorrow; that even in considering development of rational powers, it's extremely important for anyone in any kind of planning or organizing capacity to consider the individual differences both of individuals and of groups. Is this a generalization of what you've been saying?

HASKELL: Exactly. So when we say individuals, what individuals do we mean? If you will give us A, B, C, different kinds of individuals, then we can begin to address ourselves to the question of individuals' needs.

MICHEELS: And we can define it even further by saying developing the rational powers in keeping with the needs of each individual regardless of his background or his being or his ethnic group, or what have you.

HASKELL: I would say those needs are food, shelter, warmth, love.

SINCLAIR: Let's go back for just a moment.

MICHEELS: All right.

SINCLAIR: The difficulty that you first suggest--assessing the primary goal of education--is that you cannot determine individual needs. Is that what you're suggesting? That you can't determine individual needs in terms of what society needs?

HASKELL: No. Simply that you can't make a blanket statement and say that all people in our society have the same needs. You have to specify first what individual you're talking about before you can discuss what needs you are going to help him fulfill.

DE VORE: Would this not also be true of trying to characterize the society?

HASKELL: Yes, our societies are very complex.

DE VORE: Diverse.

HASKELL: Yes, diversified.

MICHEELS: But still a major function of education, having all these things in mind, is to develop the rational powers of these individuals. This is the basic purpose--not the only purpose, not the sole purpose.

HASKELL: There are also emotional powers. In fact, studies show that in our society--the British and American--there is a tendency to weaken the affective side, the emotional side, to play it down. This often has unfortunate results.

DE VORE: Would this point that you have made be opposed to the discussion last night in terms of existentialism? Does the existentialist reject the rational and reason approach? Would he be more concerned with the affective or the individual emotional aspect?

SINCLAIR: That is only an interpretation of rationality.

MICHEELS: That's right.

HASKELL: So could we perhaps say we could combine the essential and existential needs of the individual by, on the one hand, trying to help the individual to gear into broad social techniques, technologies, and processes; and on the other hand, permit him to keep his own ethnic and social structure and other particular emotional internal needs, and develop those and satisfy them? So that we would have what you suggested last night, Dr. Micheels, namely, a combination of these two things, a synthesis?

MICHEELS: Yes. I like your idea of synthesis.

DE VORE: There is one other element described in a work that has been of some significance in education --Bloom's Taxonomy of Education. In this publication they classify the cognitive which would be the rational and the reasoning and the affective. They included another area in the taxonomy called the psycho-motor. This, however, they did not classify.

MICHEELS: This is being developed out in Illinois, I believe.

DE VORE: Yes, it's under investigation there at present. But there would be these three categories.

HASKELL: Industrial arts would come under the third, wouldn't it?

MICHEELS: I can't remember the exact wordage but I take from it a generalization that they were going to address themselves to the cognitive primarily because that made up most of what takes place in the school. Then they were going to address themselves to the affective. However, because so little of the work in the schools related to psycho-motor development, they neglected that. But Dr. Simpson in Home Economics has taken the lead in developing a taxonomy related to psycho-motor skills. I think this is just another expression of the fact that we've attempted to concentrate on the gathering of understanding of knowledge and haven't been able to pay much attention to the development of feelings and values.

HASKELL: It seems to me that one thing that would be of great help here is the camps--summer camps, spring camps, and winter camps. In these the children have a chance to develop a lot of these industrial arts--you'd call them arts and crafts but it shades into industrial arts--and to practice them in their camping and in their other activities. At the same time a lot of emotional expression is constantly generated in camp.

SINCLAIR: But isn't it in a sense, perhaps in a limited sense, precisely this kind of link between manual and intellectual arts that reflects the past tradition of industrial arts which you are now trying to escape?

DE VORE: That is a question we are raising.

HASKELL: I cannot see why we're trying to escape it. We're heading toward a time of tremendous leisure, where leisure is going to be a major problem, and industrial arts gives the people a chance to develop all kinds of activities that could be used in leisure time. It could give them a way of expressing themselves and fulfilling themselves.

SINCLAIR: What you're talking about is esthetic satisfaction and I agree with you entirely, but that's not the function of industrial arts today in most schools.

HASKELL: Well might we not say then that to develop that side of industrial arts is something that the future calls for?

KATZ: The future of computers and leisure?

HASKELL: Precisely. Now we may say these are outmoded or obsolete, but in the next decades they're going to become extremely important.

SINCLAIR: Is there any reason why art departments couldn't do this kind of job?

MICHEELS: The needs of leisure time and self-expression emphasize the real challenge to blend both the arts and the industrial arts and here again we run into this essentialist, existentialist problem.

DE VORE: Is that its limit or are these ideas we discussed this morning and those McHale was dealing with--are those also, in the cognitive aspect, elements of consideration?

SINCLAIR: It would seem to me they are. I think McHale makes the point when he orders his courses be structured around certain concepts. Doesn't it occur to you, perhaps, that the kind of concepts he is using might be suitable for integrated activities?

HASKELL: Sure. For example, he mentioned photography. There are many youngsters now who are using cameras as an art medium. They see something beautiful and they just have to take a picture. It's awfully good if you can take them into the darkroom and teach them how to develop these pictures and to bring out the things they consider beautiful, which is an industrial arts type of activity.

MICHEELS: I may be wrong, but I think we're getting toward an operational definition for our purpose. Are we ready to make a tentative one? I think we are agreed that we do not want to lose that part of educational experiences in which young people learn to use tools and materials. Whether or not it is taught by the industrial arts or by the art department, can we agree that this past aspect which has characterized primarily industrial arts, wherever it's taught, should not be omitted?

SINCLAIR: Let me enter a minor caveat--not that I disagree but rather is it not likely to assume that these kinds of skills, interests, and so on, will, in the future be outside the area of industrial arts? Perhaps these might be classified as arts and crafts activities.

MICHEELS: Boy Scout activities?

SINCLAIR: A wide variety, a whole panoply of community-supported activities of this type, that will give expression to these kinds of desires and needs. Isn't it a possibility at least that those organizations may be a more vital means of supporting this kind of activity than industrial arts would?

DE VORE: Including continuing education.

KATZ: There seems to be some confusion. I was considering these manual dexterity skills under recreation. Would you say that recreation occupies time outside our formal educational institutions? We would find the recreation people objecting to this. They believe the role of education is recreation among other things, the teaching of educational possibilities. But I too would agree that there will be a place for this. I would then question; do the people in industrial arts see this as their domain? The understanding that I have is that they do not, though it may have been in their past. Theoretically it should not have been in their near past, though apparently it's still in their present. In their future, I would argue from my own understanding of industrial arts people that they do not see it as their program. Their concern is in helping the individual adapt to his society along the lines of understanding industry. Industry is the wrong term here but modern industrial society would perhaps be a good term.

DE VORE: We're moving through that phase, also, into another era that's beyond industry as we currently define it. But I would like to raise a question which I would define as the myth of leisure. It appears to me, as you observe this phenomena of leisure, that it really doesn't exist as the educational level of individuals is increased. The people I know in the professions and with other high levels of educational development have less leisure than those who are uneducated. If we continue to increase the educational level of individuals and move more into the system McHale sees developing and which many other people have written about, the cybernetic era, I am wondering if new modes of work and living are not going to occur. The other element of leisure is that it isn't a matter of how much time you have free, but it's how free the man believes himself to be.

HASKELL: Appropriate to this point is Huxley's "This Brave New World", in which leisure in the brave new world is really enforced leisure. It's really no more leisure than work is because you have to do it. You have to account for it as leisure time.

MICHEELS: Maybe another way to put it is that it may be necessary to get a new definition of what we mean by work. I think we're rapidly approaching that point in which work was a fundamental of life. You had to work in order to live, to eat, or have some place to sleep. This, before too long, may not be a necessity in the sense it was previously.

DE VORE: It's a value judgment. In our society there is a great amount of emphasis on work which comes from the Protestant ethic that work is holy and next to Godliness. I would like to raise another question on leisure as a primary concern of industrial arts. Should leisure be of any greater concern to the field of industrial arts than it is to science, or art, or literature, or language, or any other field of human endeavor? Each of these have components in which a person may spend his free time. I read, for instance, history as a pleasure but it also has aided in my professional endeavors. My daughter is interested in rocks, in geology. When she gets an opportunity she'll move into this field which is not the domain of industrial arts. Others will develop, from studying, interests and motivation to pursue further as a hobby or as a reader activity.

HASKELL: I would certainly agree this is true of the upper-middle, lower-upper, and upper-upper classes, which comprise about 12% of the population. But the lower-lower, which is about 25%, the upper-lower which is about 25%, the lower-middle which is about 35%, are not going in for music, literature, and so forth--very much, except in the folk fashion where their instruments and so forth shade right into industrial arts. Their level of music is not that of the conservatory; it's that of the folk people. It seems to me we must not lose sight of the tremendous number of dropouts. All those dropouts have leisure time. We don't seem to really include this in our concept of leisure time but it is leisure time, and there is going to be a tremendous amount ot it--in fact, there is a Society of Cybercultural Research, headed by Dr. Alice Mary Hilton. They feel that work is obsolete, that there is going to be an era when practically nobody needs to work. Actually they're exaggerating a bit I think. But still it's a terrible thought that people might not have something to do.

DE VORE: Right. My only reason for mentioning this latter--the myth of leisure and the functions of different areas of study in terms of the leisure--was to raise the question of what is unique about this area of study which we now call the industrial arts? And what are its major contributions? I would agree that the contribution toward leisure for man would be a contribution it could make but is this the prime contribution? I'm trying to focus on the prime contribution and then draw the pyramid or try to find the peripheral contributions the field can make.

MICHEELS: Dewey and Bonser conceived of industrial arts as being a basic aspect of elementary education, around which elementary education was to be actually developed. In the last few years there have been a few very interesting development that I don't think can be lost track of. They have a very fine program in New Jersey now with industrial arts in the elementary school. We will be hearing more and more about this program.

KATZ: Excuse me. You're thinking of tools of industry?

MICHEELS: Well, using tools in a material sense. You see I'm talking about saws and so on.

KATZ: Industry--what's that? I was wondering whether you were aiming at what conceivably could happen in social studies at the elementary school level where the teacher who is expected to explain what happens in factories might utilize this kind of industrial machinery. I am not sure how, perhaps on a model scale. Apparently this is not what you are describing.

MICHEELS: This is a form of learning activity that brings more meaning on a first-hand experience basis rather than just reading about that factory in a book.

KATZ: But does our factory use saws and hammers?

MICHEELS: Well this again is a challenge of how to do it. I agree with your implication that the idea of using tools just to use tools is not what we're after.

SINCLAIR: If you're talking about elementary education, perhaps you have to talk about it in a different fashion than when you talk about it at the secondary level; I don't know. But as it shapes up in my mind it seems to me that what we're saying is: "Is industrial arts to be related to work and all those things which pertain to work?" For example, isn't it possible with an educational technology to leapfrog this element and deal with the concepts of the new technology?

MICHEELS: My own personal feeling would be that the elementary teacher should use the tools and materials of industry as a teaching tool rather than as a separate discipline itself.

KATZ: I can't agree with you if you are teaching social studies at the elementary level and the teacher, for example, wants to get across some of the disabilities of pioneer life and the teacher decides to have her students (and I'll exaggerate a little here) cut a tree down and somehow or other connect it with pegs, using an adze to do what an adze does. If a teacher, in attempting to teach about the Pueblo Indians had her students make adobe blocks, to this degree, I would say fine. There is some degree of relevance. I would question how much of this should take place.

MICHEELS: This is the real challenge. But carrying things to another extreme, I've seen what I call a negative example of where the child spent hours and hours making a replica of the Parthenon. To me his time could have been spent to much better advantage. They could see slides of the Parthenon, or a model of it. This is where good teaching comes in.

KATZ: Agreed! Where it has no direct application, it has no direct learning increment. An example would be, again using the Pueblo Indians, the teacher having the youngsters build a Pueblo out of cardboard boxes. I see very little value to this use of time. In the comparison of the different societies and the things the people in these various societies did to provide shelter, I can see perhaps some value in this approach.

MICHEELS: Maybe 1 or 2 adobe blocks, just so they know what adobe is, rather than a picture or cardboard model.

KATZ: Now the question is, how well does this teacher have to be educated along these lines?

MICHEELS: What you're questioning is how many skills. How much skill training.

DE VORE: I wonder if it's how much skill training or how much real knowledge of the area we call techniques and technology. How much background is required for these examples to be brought in, studied and utilized? The phenomena, as it existed, had a function in the particular society. What way did it support the society and its culture? How did new technical developments, as they were introduced, change the society? Are these functions of the study of this area? Or is it merely necessary to present to the teacher certain manual skills such as cutting cardboard to build molds for adobe blocks and et cetera? These become very secondary to the support of governmental tribal structure of the Pueblo Indians. What is to be emphasized? Is it just the "how" of making things or the idea behind these things as they fit into the culture?

HASKELL: I'd like to show one correlation which I think is very germain here. You remember the old law that ontogeny capitulates phylogeny. The child goes, in his life, through the stages that the race went through. Little kids like to do the kinds of things the lower hunters did and still do. We used to play with bows and arrows and so forth, and loved it. To study what the lower hunters did is very germain at that time. Later on we developed further and we liked swords and shields and the kinds of things the medieval knights did, and it again was germain at that time to study the Middle Ages. As the children of parents of higher social strata will have the necessary high levels of abstraction, they can keep on advancing until they really understand computers and what our civilization is doing. Many of these children who are in our sphere will never understand that. They will only have what we call mimesis. They will have certain vague ideas which they get in terms of the vocabulary and ideas that they are capable of understanding. So it seems to me that industrial arts, as I understand it, is extremely important today for at least lower-lower, upper-lower, and lower-middle and for all other children too through the grades and lower high school. As they go further, they separate themselves. Certain children become very much interested in electric motors and can manage them. Other children go further and become radio hams, and engage in other activities of interest to them.

KATZ: I question, of course, that our upper class youngsters will have a better understanding of electricity than the lower class youngster. I question the whole model that you have described, but not your logic.

HASKELL: I'm speaking statistically. I'm not saying that all the upper class--I'm saying there is a higher proportion of the upper classes than of the lower classes, and that has been shown.

MICHEELS: That is right.

HASKELL: Precisely so. You cannot escape it. Try to all you want, you are just going to run your head into a rock wall. You will never escape it. This is the way man is built. All nature is built this way, in a systems hierarchy.

SINCLAIR: But in other ways, is it not also true that traditionally industrial arts has served precisely this function? That is to say, it has given some sort of education to people who were otherwise minimally educated. Except that it was predicated on an industrial system which could incorporate those people at a given level. And that is changing--certain factors then indicate the educational system must also be changed.

DE VORE: Your point has some validity. As we have analyzed the status, what you say is true. The function that most industrial arts courses have served in the public schools has not been for all students but for those who do not perform well in academic, abstract, symbolic course work. However, if our analysis of our society and culture is valid together with our assumption about the need for all students to understand our technology, then can they not be taught at certain levels of conceptualization? Can we design programs for various types and levels of intellect and ability? Those capable of moving ahead and understanding the cybernetic system as it is developing in the electronic era would receive certain kinds of courses at certain levels of conceptualization whereas those from the lower group Dr. Haskell refers to would have a different level of conceptualization and a different program, implemented by different methods and stressing different intellectual processes.

MICHEELS: Putting it another way, there are those who are very critical of the tendency to eliminate non-verbal people or troublemakers from an industrial arts class. They say, "Well, we can ride herd on them and give them busy-body work." These are the very people who need the academic disciplines at the lower level such as reading, writing, and arithmetic. We need industrial arts teachers who can assist in this process.

SINCLAIR: Paul makes a pretty good point. The fact that there are different levels of ability to abstract doesn't preclude the possibility of some kind of ability groupings within this framework. My point is that if you maintain industrial arts as it has been in this particular sense, you are not only dealing with people with potential for achieving at a higher level but you may destroy the opportunity for them to do so.

MICHEELS: Are we ready to give a tentative operational definition to delimit our consideration of industrial arts?

SINCLAIR: In some respects. Here is what I have. Given that the development of rational powers is the primary aim of education, it is nonetheless difficult to make a blanket statement of individual needs. The diverse nature of society would seem to suggest an educational system which would be sufficiently flexible to allow for individual variation of need. Does that capture the situation?

HASKELL: Yes. Only I would say that all children benefit from industrial arts--the slow and the fast, the socially privileged and the not privileged, and the industrial arts, to my mind, is the common denominator which we, all as human beings, can share and enjoy and which we can use in our own lives as individuals and citizens, as employees in our industry and in our nation. Since we are all children, for some part of our life, it seems to me that these industrial arts are something that all people of any social stratum or ethnic derivation, or degree of talent, can profit from, enjoy and use.

MICHEELS: I think we have got to say what we mean by industrial arts.

HASKELL: I would say that industrial arts is on a continuum between arts-and-crafts and vocational education. The continuum then goes on into engineering and technology. We have a graded spectrum of which industrial arts is the second member.

MICHEELS: But still, that is not very operational. Vocational education is such a nebulous term.

SINCLAIR: The problem is there is a traditional definition of industrial arts which jars the concept of what it might be in the future.

HASKELL: I would say the traditional one is perfectly acceptable, except we will have more art, perhaps, in the future, because of the increase in leisure.

SINCLAIR: Isn't it true that changing technology is one of the reasons for reconsideration of the industrial arts? This may, as a matter of fact, bring about changes in distribution, changes in production processes and so on.

DE VORE: I have a definition which I have proposed. However, I am somewhat in a quandary as to whether we should deal with a definition or not. Definitions have a tendency to limit further consideration. Once you define it, it is rather difficult to extend beyond the definition. But in this one aspect, I would like to combine two elements which are relevant. They are man and technology. Industrial arts, if that is the right term, would be the study of man and technology, including the technical and cultural-social elements. It would be the study of man's creative endeavors in meeting the needs of individuals and cultures in the areas of production, transportation, and communication, through the utilization of the properties of matter and energy. This, of course, can be at any level. What I'm emphasizing is the human element which is often left out.

MICHEELS: Would it be helpful to you, in terms of a start at an operational definition, to call it a study of man and technology?

DE VORE: I could accept this. The human element is very important. What does exist was created by man. Intellectually he created it, through innovation and invention. He developed it. If you leave out this aspect, which I think is very important, you make it a technique devoid of the human element. Unless you consider man--past, present and future, unless you look at him in relation to his society, you get a rather sterile area of study; the manipulation of tools or the manipulation of materials or the processing of materials for their own sake. It would be, to me, the same as memorizing history chronologically without getting insight into a human being functioning in certain eras of political, economic, technological activity.

MICHEELS: Immediately, Paul, you get enmeshed in trying to relate this to the traditional in industrial arts. Can we agree that here is a radical, entirely new field of study called man and technology? I raise a question. Then I raise a further question. Can we still say that there may be a place for traditional industrial arts in education? Could we agree that the unique contributions might be: (1) to help young people learn to solve problems by using the tools, materials and processes of industry; (2) to help young people learn how industry uses tools, materials, and processes to solve problems, and (3) to help young people develop the means of personal communication, expression and adjustment to the use of tools, materials and ideas. That gets over into the aesthetic.

HASKELL: It also seems to speak to the fact that young people who are not in the popular stream, who are not sophisticated and so forth, need simpler tools and not the highly sophisticated things that industry and grown-ups require. And so, industrial arts is a means of introducing them. By means of a hand saw you progress into using a power saw, and so on.

SINCLAIR: I would like to comment here. You could spend an eternity trying to define what industrial arts is but in terms of our objective, since we're heading toward an identification of the knowledge or concept reservoir, we have got to come up with some kind of a definition that will allow for advancement, for adaptability to change. In respect to your definition, the only thing that strikes me about it is that the emphasis is traditional--it is on industry. I'm not sure that is going to be a significant emphasis 20 years from now. If the question we're really going to be concerned about, for example, is the problem of urban transportation, then industrial arts doesn't involve industry as we have traditionally considered it.

MICHEELS: Let me attempt to get this back in perspective. You have two jobs to do. Don't try to play around with industrial arts and get all involved in a maze. Start from the whole topic of man and technology.

SINCLAIR: That is precisely my point.

MICHEELS: However, I sense you feel that whether this is a good definition or not, you still want young people to have experiences with tools, materials and processes.

DE VORE: Yes. Didn't McHale say this morning that this was vital? As you look at the problems which relate to various developing systems of communications, transportation, and production and the new technology which is new for every generation, as history shows us must come through, as he indicated as practical work.

MICHEELS: What you have to do then if you accept this challenge of man and technology as being the basis, is to develop a conceptual approach as our people have. The reason it is called American Industry, I'm not sure that is the best name, but the reason for it is that we sensed very early this thing I was talking to you about. My point was, let's not argue about that. Anytime you want to change the title, change it any way you want. But don't call it industrial arts because you are going to get back into the same old maze and come up against a blind alley.

SINCLAIR: I'm strongly in favor of the man and technology approach. Or instead of american industry, somehow spell out that you are talking about human problems that are technologically derived.

MICHEELS: Someone will say that belongs over in social studies or someplace else.

SINCLAIR: Not if the technological connection sticks.

MICHEELS: That's why I would like to see technology in the title, for that very purpose.

HASKELL: We ought not to be exclusive. Technology, fine, but also leisure and industrial arts. When we say, "In the past industrial arts was this, now it is this, and in the future it is something else", it is really something cumulative. Everything that is in the past is fine; we can add something now, and even more things can be added in the future.

SINCLAIR: This reminds me of the internal development of the history of technology, in the sense that as an intellectual exercise it starts out essentially antiquarian. The individuals who are pursuing the study begin by attempting to develop taxonomies and structures in an effort to identify the larger elements. This approach is especially valuable if it provides a direction which identifies a structure, which in turn begins to make some sense. There may be a corollary in the area of industrial arts. Industrial arts may very well have passed through this phase. There is some evidence that the transition is taking place since there has been a continuity to the field. It now must become something else, if it is to maintain its relevance as a field of knowledge.

MICHEELS: Can we agree we have two things thare we are identifying? One is man and technology and all that implies. We also seem to feel that young people still need to learn something about tools, materials and processes. The two should not necessarily be exclusive but for the purpose of this project you might very well confine at least your initial efforts to man and technology.

SINCLAIR: In my mind there's no conflict here, in the sense that the title man and technology allows for--as Paul has suggested earlier--some kind of rational ability to do things within the framework of a larger intellectual structure.

HASKELL: But also man and work--not just technology.

DE VORE: I wonder if there isn't an analogy of this in terms of economics. For instance, the old economics built on--to simplify it: supply and demand. Then we have Keynesian economics which incorporated the old but went to a much broader spectrum of considerations. I would see, in reference to your question, as I have studied it, that the elements which concern Professor Haskell would be a part of the study of technology at some level and at some stage. I do not see how we can reject tools or art but the focus of study, the question and central themes are different. We have a different rationale.

MICHEELS: From the practical point of view, at this stage of your research and development, you should concentrate on man and technology, not exclusively, but to avoid the trap of getting involved in the maze of what industrial arts traditionally has been. Concentrate on this and after you have the structure, the knowledge structure, pretty well organized, come back and see how some of these things fit into these various groups. Would you agree with that?

SINCLAIR: Man and technology opens it up. When you speak of technology in an industrial sense you're talking about, more often than not, a closed-in situation which describes traditional occupations rather than methods of thinking.

DE VORE: I wonder, in terms of your work, Professor Haskell, as you have tried to synthesize the various sciences, did you reject any? Or did you incorporate them in a new, more inclusive structure? This structure would not reject what belongs. But it takes a whole new approach which I think you are encouraging. It is a new look, a different attack, a different direction. It is an attempt to synthesize technology as you are the sciences.

HASKELL: As long as you leave the door open for arts, as well as technology, I agree.

SINCLAIR: Perhaps I have stressed this but it seems to me the use of the term industry or industrial in your terminology connotes certain things which may no longer be appropriate. In the term industrial arts, industrial has connotations. It has connotations of ways to process things, the functioning of people within some set kind of occupational framework, and these are past connotations. I am not sure they are relevant anymore. That is my only objection to the use of this kind of terminology.

MICHEELS: The approach, it seems to me, whether you call it American technology or American industry, includes these basic concepts: communication, energy, transportation, finance, processes and materials, property, research, procurement, relationships, marketing, and management. Aren't these concepts somehow going to be put into operation?

DE VORE: Those are elements included in many structures. They are a part of the whole. They are here. We can't reject them if our approach is concerned with industry. If our approach is the study of man and technology, some elements would be excluded, others included.

HASKELL: But architectural styles, designs, and so forth, are also a part of it. They are also helped by industrial arts. We shouldn't exclude them.

MICHEELS: Would it be helpful for our purpose if we moved to B in the outline and concentrate our attention on identifying the knowledge or content reservoir relating to a study of man and technology? We should consciously limit ourselves to the idea there is a oneness of knowledge--a synthesis--which permeates all of them.

DE VORE: From the practical standpoint of an educator, the search should be for some of the unique elements. We will have to delimit our considerations in some way because there is only so much time for formal education in the public school. I think the intent of our question should relate to those unique elements of the field of study; the primary elements of it, the universe of content. What are the major components, not the peripheral ones, recognizing they exist, but the main categories?

MICHEELS: In other words, what are the basic concepts you want young people to learn?

DE VORE: In a way, yes. Eventually I think we could derive the concepts. However, I don't believe this is the first step.

HASKELL: It is very difficult for me to discuss this before I've had a chance to give my presentation this evening. A lot of the things I'm going to say are prerequisites to what I'd like to say now. I can merely say one thing, and that is, that I believe we are on the threshhold of being able to teach children a fairly coherent concept of the universe, from atomic particles to human civilization. It is, in your technical sense, a single discipline and can be stated in many different levels of detail. I have given lectures to grade school children with very good results because, I suppose, I used grade school language.

MICHEELS: This is the challenge! Bruner says we can teach young people anything if we learn how to teach it in the way they learn it. The way they learn these things is the real challenge of the psychology of learning and the research that is going on there.

HASKELL: So far as I can see, what you are saying in no way excludes providing the industrial arts students with what the Greeks would have called an education, a philosophy, as well as all the techniques and technology you have specified.

MICHEELS: Let me ask a question. Was it your feeling, after listening to McHale this morning, that possibly the approach and the work that has been done by Fuller and McHale is at least one knowledge source or reservoir which might very well serve as a starting point? Shouldn't we make use of what they have done? Probably they would be interested in seeing this put into a curriculum. Are there any other sources, for example, Bruce, from your background?

SINCLAIR: I was very much taken by Professor McHale's remarks and his point of reducing the study of technology to specific concepts. The historical content would be applicable to contemporary problems because you would be using the same concepts, using the same intellectual framework. By using his concepts, you can also talk about a different kind of industrial arts program. For example, you could talk about the history of technology, and man-made society. I am very much taken by these possibilities because this enhances the opportunity to work across interdisciplinary lines. This is the value of restructuring the field of study, so that you can utilize people from other disciplines to deal with these concepts, each within his own framework. Unless you adopt this direction for the future, any effort that you engage in will probably be unsuccessful.

MICHEELS: Let me conclude this part of our discussion by saying that the work of Dr. McHale and his people, plus what we're going to hear about Mr. Haskell's approach to synthesizing knowledge, might be a very important reservoir as an approach to this project. Have I said this correctly?

HASKELL: All I can say is, Amen!

MICHEELS: Now we move to item C--identifying the characteristics and competencies of the individual who will serve as the teacher.

SINCLAIR: Before we do that, could I ask Paul if there is any possibility of sketching out his own conceptual framework; what kind of outlines would he give to his structures? Would he follow along some of the same lines that Professor McHale has suggested?

DE VORE: From what I understand of the work of Dr. McHale and Professor Fuller, there is considerable similarity to what some of us have been doing in attempting to structure technology. This evening I am going to attempt to provide a quick overview of a tentative structure. From this I hope to get comments from each of you. Following that, Professor Haskell is going to carry it one step further. So I think we have a framework which could prove profitable.

MICHEELS: Let us return to item C. The first thing, it seems to me, is that the educational program would have to be very definitely interdisciplinary for the individual who is going to teach in this area. This is one thing which comes immediately to mind. It also raises a question. Will the resources of the University be available to do that? Another thing and a very important thing for this teacher, is that he must really have an understanding of the conceptual approach to learning. This is a hard thing to get across, especially to teachers who have come up a different route.

DE VORE: One of the assets we have going for us at West Virginia University is we are not attempting to retrain teachers who have already been trained otherwise. What we are attempting to do is design an entirely new undergraduate program which will prepare a person who can teach not only what is but can adapt and change to meet the future.

HASKELL: I would say that the word interdisciplinary is the nearest approach we have. But in my opinion it is not nearly a valid concept. I've sat in many interdisciplinary courses and discussions where people of different disciplines were talking, each in the language of his own discipline. The four walls, in the end, were supposed to provide the synthesis. There is a long process. We have been at it 27 years. It is the difficult process through which the disciplines can be fitted together, can be assembled, by making certain changes in theories here and there. As a result (if we had the backing of the administration of the university) we would have, right now, the basis for the kind of education we could validly call interdisciplinary. It simply does not work when it is done on the basis of putting together parts which never were intended to, and really don't fit together.

MICHEELS: It's multi-discipline.

HASKELL: Call it what you will. It is a difficult process. Students cannot do it by themselves. They develop internal conflicts because it is simply not possible for the ordinary individual, unless he has given his life to it, to see how these things have to be modified and how they can be fitted. The kind of research that seems to be developing at Stout University may provide a way, a method for certain kinds of teachers who will hardly be capable of teaching in this way, which might be of great practical value.

MICHEELS: This is called the psycho-vector analysis.

DE VORE: Yes, I am acquainted with it. I've corresponded with Dr. Hunter.

MICHEELS: He claims psycho-vector analysis, which is based on cybernetics and grows out of research he did in South Europe and Africa from which he developed a three-dimensional model, can do a much better job of identifying all human feelings and patterns. He has developed many charts and graphs. If his predictions are true, it will be a real breakthrough. He is going to defend his thesis at the Sorbonne where he received his doctorate. I wish you would invite him to visit you when he is in the New York area. He is looking for people to react to his ideas.

HASKELL: I have written him that I would very much like to become better acquainted with his work.

MICHEELS: What we are saying is that the teacher for the study of man and technology has to be an entirely different type of individual than the traditional teacher.

HASKELL: However, this teacher will have to know his or her stuff as far as the use of machines, tools, methods, and materials is concerned. They also must be competent in teaching boys and girls industrial arts as well as the other.

SINCLAIR: I am concerned very much with something Bernie suggested. He said the teacher should be competent to teach his or her students something of the "language of the machines."

DE VORE: We have discussed the nature of this person. We believe it will be necessary to write the description in behavioral terms. He will be able to perform in such and such a way. However, because of the nature of the discipline with which he will deal, we have hyphenated the term describing this individual. We have indicated he must be not only a teacher in the common sense of the term, but he must be a scholar. He must be a student who continues to learn, reevaluate and reassess himself. Many teachers today in the industrial arts in our public schools wait on developments from someone else. This seems to be unique to education, because if a person is really engaged in the scientific community or a literary community, he creates himself. And he has his own attack and his own scholarship which he is pursuing. This is going to require a different attitude on the part of the teacher. He will have to be prepared differently and must view himself differently.

HASKELL: These are rare individuals, I think.

DE VORE: Yes, definitely! We have thought about this and are concerned. But also we listen to what McHale says and read Schon's work, study the President's Commission on Technology and the American Economy, read what scholars say in Technology and Culture about this phenomena, listen to people at the Smithsonian who have studied the history of technology, plus many others. Is this too ambitious a task for the public schools? Can we provide this kind of background for a person? Is this a wrong assumption that it can be done?

SINCLAIR: It seems to me there is one element in considering a person like this. If man and technology, as McHale suggests, continues to cast problems in terms of changing contemporary issues, there is a dynamism which is not altogether present in current programs. The problem of constant change may give the person incentive to continue to study and investigate and that may be the kind of spur or stimulus you are looking for.

HASKELL: And as Dr. Micheels said earlier, it is the students that teach courses to the youngsters.

DE VORE: Dr. Sinclair has a point. Many of our teachers enter the public schools from teacher education programs, with what many people say is a "kit of tools", or a bag of tricks. Every student gets the same thing, semester after semester. Now the creativity you are interested in, or the artistic element, is not permitted to permeate the structure because the teacher has so highly structured it he doesn't adapt to individually.

MICHEELS: But it seems to me West Virginia University has an opportunity to make some radical changes. The objective need not be to cover so many pages in 18 weeks, but to take each student and help him learn how to learn in whatever way may be necessary.

SINCLAIR: To be meaningful, you deal with a given product.

MICHEELS: Here again it is not what you say but how he hears, and feels.

HASKELL: And to some children, something that seems to us incredibly simple and unimportant, to them is an achievement; and to them is very satisfying. It is very important we allow them to have this experience. We should not discredit it.

MICHEELS: I'm convinced that in the course I told you about yesterday, the process is going to be much more important than the subject matter. The subject matter is going to be entirely secondary.

SINCLAIR: But with regard to problem 1-C, the bag of tricks all too often comes out simply as a smattering of knowledge, or at best a miscellany of things which in fact define the nature of a bag of tricks.

MICHEELS: But let us say you get a scholar. Again I must refer to my own institution. We were very fortunate in obtaining a very able chemist from the University of Minnesota who had been at a medical school for years and finally decided that he was through with a big institution and through with the big city. He set out to visit all the institutions in our whole system. Luckily he decided Stout was where he wanted to come. He is a scholar and his wife was head librarian at the University of Minnesota. The fact is he is a scholar. He is a humanist as well as a chemist. He does his own research and has his research laboratory in his house. But he came to the conclusion that some of the students were not learning chemistry because they tended to have a creative approach to things, rather than a strictly verbal. So he asked permission to try to identify these students with high creative potential, put them into a separate section and teach them entirely different. This he did. He is not doing it now because of the measurement problem. It took him too long to go through all the tests on creativity that it was just overbearing in terms of time. However, he still believes if he can find some way to identify these people easily, he can make a contribution to these students.

SINCLAIR: But the essence again is his teaching area. I presume we must establish some kind of relevance somewhere along the line. It makes sense and it strikes me as a critical element. How could you not, for example, include the concern for some of the new tools of technology and the area of cybernetics?

MICHEELS: In other words, you are saying it will be necessary to introduce some new learning experience, or new courses, or whatever. I think another dimension though, maybe a starting one, is selecting your students. You must look very carefully as to their attitudes toward kids. We have found that attitudes during college don't change very much. Cook's Teacher Attitude Survey showed that very well. So, maybe a good part of the problem is in the selection of the right kind of person in the beginning.

DE VORE: Can we go back to the point you mentioned about the necessity of the individual being educated in the processes of learning? I would like to extend this to the processes of the discipline, how the discipline works, not what it has been, but how the people of the discipline go about accumulating knowledge. Our discussion this morning touched on the fact a discipline is cumulative. It is cumulative because it utilizes certain processes for adding to this knowledge, certain ways of approaching and solving problems. This would mean the future teacher would not enter teaching with a fixed body of knowledge to transmit to students. He would be prepared in the processes of stating ideas, problems, and in solving problems. Is this what your chemist was doing, dealing with the processes of chemistry? Was he more interested in the memorization of techniques and formulae in chemistry or more interested in the creative aspect of raising the right questions, for instance? In your field, Bruce, how do you solve problems? Are you more interested in subject matter, the processes of the discipline of history or learning theory?

MICHEELS: Edgar Wesley said history should never be taught as history.

HASKELL: It depends on one's experiences. If one's experiences in history have been exciting, revealing, and meaningful, then teach it as history; if it's been something dull, boring, and stupid, then don't teach it as history. I don't think we can make a blanket rule.

SINCLAIR: But can we accept the idea of relevance as being an overriding consideration?

MICHEELS: Oh absolutely! Making education relevant is the theme of the day.

SINCLAIR: Perhaps I am overemphasizing relevance, but it strikes me that if you accept it, then we can move on a little more easily to a more precise definition of some of the competencies.

DE VORE: What would you think some of the competencies this person should exhibit would be?

SINCLAIR: I was going to suggest a minute ago some significant knowledge about computers would be relevant; how they function in our society, what their potential is for knowledge, for production, and for social problems. I would also suggest a current working knowledge of what cybernetics is, would be relevant as would be systems analysts. What are some of the attempts to synthesize knowledge, or to get at information in different combinations?

HASKELL: I would predict that some of the children considered dull in the present common school will turn out to have a remarkable aptitude for just these things. We think, naturally, in terms of systems. I have observed that people I thought extremely brilliant dropped out of school because they couldn't fit into our present teaching and isolated subjects. We will be opening the doors for some who have been rejected up till now.

SINCLAIR: I would obviously always include, in a perfectly immodest sense, the history of these kinds of relationships as an essential and integral part.

HASKELL: Could we not sum this up by saying that one should have, if possible, teachers corresponding to the different kinds of students? Under item 1 we have defined, to a certain extent, the kinds of students there are, the kinds of individuals. It would seem to me, ideally, you would have to have corresponding kinds of teachers.

MICHEELS: Here is one set of competencies: he has a consistent philosophy, relates the school to community, has support with industry in the community, relates the curriculum to society, involves sub-community or super-community activities as appropriate, is perceptive to change, perceptive of the world about him, has exceptional appearance, can conduct action research, can aid in vocational school guidance, knows school finance and administrative procedure, knows the social structure of the community, broad background in liberal and general studies, is committed to a life of learning, has effective written communications, can teach at all conceptual levels, and finally, makes a good housekeeper.

DE VORE: That is really setting forth a model, isn't it?

SINCLAIR: Yes, but isn't our task to concentrate on the qualities of a teacher in the technologies, since those that you mentioned are the qualities that have always been desired in a teacher?

MICHEELS: Yes, but this is a starting point. What does this mean in terms of the actual behavior a teacher exhibits? Knowing that, what are the kinds of learning experiences he ought to have so he will be able to exhibit the behavior? This is the real challenge.

DE VORE: I have thought about these "God-like" behaviors we set up for a teacher to meet and I have rejected a number of them. In the field of industrial arts I have rejected the fact that if a teacher doesn't keep a clean laboratory he is a poor teacher. I reject this out of hand. Some people say if he doesn't use all of the resources of industry, doesn't take field trips, or many of the other little items that belong to the kit of tools, he's a poor teacher. And I question, as many people have, what is a good teacher? Most of the references or research publications come to the conclusion that we don't know. This is the reason in the little effort I have been able to direct toward determining who we are and what we should be, that I've focused more on the content and processes of the discipline. I have tried to identify these and their functions. This is based on the assumption that if you have a person who functions well within a given discipline or content area and is interested in children, this is a criterion, you are closer to obtaining a good teacher than if you work from the other end such as knowing school finance, or how to keep his laboratory clean. I am exaggerating the point but I'm trying to move back to the topic that Bruce was discussing earlier. Who and what is this individual? I don't think we can produce a supreme individual but I do believe we can direct attention to his attitude as to who he is and what his function is with children in relation to certain knowledge areas, certain intellectual processes and certain community cultural and social problems in the area of technology.

MICHEELS: This gets down to where you would use this model--or a model you'd find yourself. You are not going to get very far unless you can define the objectives in observable behavioral terms. This is where the real breakthrough is going to come in all education.

SINCLAIR: Paul, may I ask a question? If you accomplish what you want to accomplish as you have just described it, that is, the teacher as much more of an intellectual being than he is a good housekeeper, are you really going to get the kind of person who can fill this set of shoes? What are the problems if the job doesn't have some meaning to match the intellectual abilities that you want in a person or if industrial arts itself doesn't have significance which somehow matches the proportional intellectual abilities of the teacher?

DE VORE: Perhaps the model will require a number of different kinds of teachers. If your point is valid, you prepare a teacher for different kinds of students with different levels of intellectual ability, versus others that could understand cybernetics, electronics and the other complicated technological developments. Our assumption is that in a participating democracy all citizens must be educated in and about technology at some level of comprehension.

SINCLAIR: By way of exaggerating, does it make any sense at all whether a person teaching industrial arts understands the administration of his own school? Does it really matter any more than it matters to any other teacher?

MICHEELS: Yes, I think so. This may be minor but he can avoid a lot of frustrations if he understands some of the things that go on. In fact, I just had a meeting before I came here with a particular department in which they were really frustrated because of some budgetary processes. It was a lack of communication but they just didn't understand how budgeting operates.

SINCLAIR: Then I submit that the history department is just as guilty of this kind of misunderstanding as industrial arts.

HASKELL: Except that they don't need as much material, in such depths.

SINCLAIR: Perhaps, except they are terribly book-proud people. They could spend all their money on books with no hesitation at all.

MICHEELS: This, I would agree, is very minor. But I don't think it's something we can completely neglect.

DE VORE: It may have real relevance though, now that I reflect on it, in terms of the remarks this morning. McHale remarked that one of the primary understandings which should be generated is the understanding of organizations. A school is an institution and this person will function within an institution. So, if you approach it from understanding the techniques and structure of organizations, then it has relevance to the teaching function.

SINCLAIR: All right, in the same sense he must learn the organization of many of the other institutions in society around us.

DE VORE: Or organization as a function within society. Certain ones have certain unique elements. There are overall concepts.

MICHEELS: Even if he is teaching history, he isn't sitting in a vacuum with just his little old history class.

SINCLAIR: Sometimes it happens that way.

MICHEELS: That's right.

DE VORE: One other point that you mentioned, Dr. Micheels, pertained to statements in behavioral terms. This has a tremendous importance to what we are doing. As you look over ways of doing things, evaluating what you are doing, about the only way to connect the two is by stating things in behavior terms. You state not what a thing is, but what it does. You can measure what it does but you can't measure what a thing is except by defining it verbally or abstractly. This is, as Ashby says, what cybernetics is. The statement of the problem and the function in behavioral terms, whether it's an electronic circuit, an individual or a teacher. Then you can measure, you can evaluate. He has certain behaviors. If you are stating operational definitions for the field, you would state those not as understanding industry or understanding technology, but in terms of being able to do thus and so. This delimits it. This refines it.

MICHEELS: Then you can set the standards of behavior; time limits, other kinds of limits or tolerance. This is where the real challenge comes.

DE VORE: The students on Haskill's hierarchy could have different behavioral goals and the teacher would know what they are and would teach toward specific behavioral goals.

MICHEELS: I have long been interested in this. Theoretically I see a program of study coming for this student coming into your teacher education program for man and technology. You hand him something as he comes in. You explain these are the behaviors you are expected to exhibit as a result of your learning experiences here. This would be easier said than done, of course. But theoretically this could be done in any curriculum. One person may be able to complete the program in 2½ years, another may take 6, in order to achieve the kinds of behaviors desired.

DE VORE: We have considered this. We have considered we would begin, not at the freshman year in college, but at the junior year with no time limit. When he is prepared he will exhibit certain behaviors, certain competencies and when he does, he is finished.

MICHEELS: I think this will be true as we understand this synthesizing idea, and the definition of behavioral traits. This will be the breakthrough. We can get rid of the whole credit system, semester hours, all these things. We would be able to say, "These are the behaviors we want you to exhibit in this particular discipline." When you reach this point, you will have reached this competency level.

HASKELL: Yes, but that's what an examination does. It says, can you display, can you exhibit the three-dimensional Cartesian coordinate system? If yes, show it.

MICHEELS: In mathematics it's a little easier to do it than any place else.

HASKELL: But in chemistry or physics, and other disciplines, it can be done to some extent. I think the good teachers or professors try to make it possible for the student to show what he has obtained.

DE VORE: But there is one thing that is different in our present approach. It is the difference between being active and performing, or being passive. The behavioral statements demand that this person perform and that he be active in the process. It would be possible, it seems to me, to take a course in chemistry and to pass the course without being able to perform in this field, because his performance is paper and pencil. It's not chemistry. And I would say this is true in the field we are considering, the industrial arts and technology. One of the key elements of technology is overt performance.

HASKELL: Yes, but the chemistry professor knows what performance the student has done in the lab. He knows whether he has been able to solve lab problems that have been given him, and so on. His performance in the lab is a simulation of what he would be doing in industry. So I wouldn't go so far as to say it will eliminate credit, exams, and so forth.

MICHEELS: I meant credit in the sense that we've had it--and certainly there will be exams, but I think they will take a different form.

DE VORE: Were you referring also to the fact that different individuals would take more or less time in the program and the learning situation would be more individualized?

HASKELL: One other thing we need to remember. I have observed that a couple of weeks before exams the library is always full of students. And I wonder why on earth we couldn't have students there all semester long? Why should the library be half empty or two-thirds empty? The answer seems to be pressure. The student knows that he doesn't have forever, that this is the deadline and he'd better get ready. We need them both I think. There are some students who, no doubt, instead of failing, would succeed if they had more time. Maybe some flexibility is a possibility.

It seems to be very much a question of the individual; what works for one may not work for another. And the criteria you read for the teacher--if a teacher had these capacities, the teacher would be able to evaluate how best to deal with each individual student. One needs one thing; another needs a different thing.

SINCLAIR: Again my only concern about this set of ideals for the teacher is whether, in a significant way, they state the need for a teacher who may very well want to teach something new? Does the list define the kind of person you want?

MICHEELS: It does refer to sensitiveness to change.

DE VORE: Would you want to state that as a point? What kind of individual would this be?

HASKELL: McHale made the point in his talk about people having to be retrained about 5 times now, whereas formerly you trained them once and that was for a lifetime. It seems a question of knowledge acceleration, and increasing necessity for change, and re-structuring an individual's thinking.

SINCLAIR: Perhaps simply restructuring the curriculum itself accomplishes what you want to accomplish in a teacher. Perhaps that's the problem rather than any set of ideals as far as what a teacher ought to be.

DE VORE: I talked with Dr. Drake about this earlier. In order to have a person who looks at change in a positive way, isn't it necessary, if he exhibits this behavior, that the curriculum he goes through is a fairly broad curriculum? Wouldn't a diversity of experiences be best rather than a narrow curriculum? And shouldn't he have experiences, also, outside the institution of education as he gathers this experience? Isn't this vital? A semester off campus in some other experience?

MICHEELS: I do think, though, there's someplace--I'm not sure what place--that every student at the undergraduate level should have an experience in depth in something. As you say, he must know his stuff in something.

DE VORE: He must have expertise.

MICHEELS: Plus another quality of learning, how to learn in other areas where he may have had some initial experiences and finds when he gets out teaching that some kid raises a question he can't answer. He knows how to go out and obtain that knowledge or skill. That's what we said, but we were talking about the tradition, trying to relate to the traditional. The teacher would have some breadth but not a lot of specialties. Say for example he is called upon to teach a course of welding. He may have had some initial experience in welding but the essential thing is he knows enough about the scientific and technological principles of welding. His job then is to develop the manipulative skills which come through repetition and purposeful experiences of many kinds. This would be the ideal. I have seen people of this kind, sort of jack of all trades, guys who can do almost anything. You can find a lot of these guys. Maybe they didn't go to school but they are probably intellectually very able in terms of understanding mechanical principles.

SINCLAIR: Paul, for purposes of some kind of summation, how do you want to suggest that this teacher have some intellectual background?

DE VORE: I think he would know how to deal with ideas. This connotes an intellectual approach. I am not using intellectual as a snobbish thing. I think it is a mental function that must be clearly understood. I suppose the best way to state it is that he is a student of his discipline and the discipline has an intellectual quality.

Thursday Afternoon
November 9, 1967
Group 2 - Discussion Session
Dr. William Drake, Chairman

DRAKE: This is group 2, composed of Bernard Muller-Thym, Kenneth Dawson, Thomas Brennan, David Allison, and Bill Drake. We are going to be considering topics A and B on the outline entitled: "Background and Data." I suggest we proceed with each of us commenting first on point A and second on point B.

MULLER-THYM: Let me react to point A. It seems to me that in any consideration of educational needs we would be concerned with the needs of individuals--such as how to relate himself, either in a situation where he is employed, to society considering the kinds of transaction among men, the kind of work, the kind of languages, and the methodology of associating with each other in certain common tasks in our society. An individual needs to get an introduction to the language of the associated roles and some feeling for the environment in which he will be functioning when he gets out of school. Is this one set of needs?

DAWSON: I would like to focus on the word environment which you mentioned. It has been said that the current generation of people is the most ignorant group of people who have ever lived concerning the environment or in understanding the total environment. I am not saying that we are the most ignorant people who have ever lived but the environment simply is getting so complex that people cannot understand the ramifications. They cannot purchase intelligently. They cannot consume intelligently. A great deal of confusion, a lack of communication, has to do with the lack of understanding of those things around us.

If technology is the content area of the industrial arts, it seems to me that simply making people literate in this area of their own environment, the technological, would be a major function of the field of industrial arts. I personally believe that industrial arts could well be a study of technology; it would be the domain of industrial arts. There are numerous technologies--medical technology, for example, and other types of technology. I don't think we can have a content area which is too broad but industrial technology narrows the field somewhat.

ALLISON: I would like to say a word about the term environment and the importance, from my view, in thinking of the total environment and technology's impact on it, and, further in thinking of how to introduce this question in an industrial arts program. We are learning as time goes on that every civilization, from the Sumarian civilization to our own, has been affected by--and sometimes tragically affected by--civilization's tampering with its environment. In some instances, civilizations have perished because its people did not understand the seriousness of the relationship between man and his environment. In our civilization, because technology is such a powerful force--much more powerful than in any previous civilization--it is all the more imperative that each citizen learn something of the interrelationship between modern technology and his environment. I think, to cite a specific example, of what Barry Commoner has been saying for some time in this regard. Commoner is a biologist; his field of professional interest is the environment. He warns that we dare not go much farther in disrupting our environment. But he has a positive comment too and it relates to the nuclear test ban treaty. Commoner believes the treaty is now law because an informed citizenry made its views known to the national legislature; he cites the fact that congressmen and senators were impressed with the response they received from their constituents. Legislators were impressed by the fact that citizens not only knew there was such a thing as Strontium 90, but they also knew how to spell it! And that is why I say your program at West Virginia must talk about the relationship of technology and the environment.

DRAKE: It seems to me that one of the educational needs of individuals in society--that industrial arts could assist in--is to enhance students' ability to adjust to change. There are lots of ways of doing this. For instance, the tendency towards strengthening of curriculum in basic science, mathematics and humanities in the high school is one way. Industrial arts might include making the citizen more familiar with the reasons for industrial change. For instance, why is it that in the year 1975, a high school graduate will be partly obsolete five years after graduation? Why is it that he is going to have to retrain himself for a new vocation? What are the forces that are bringing that about? What are the new technologies that are causing this to occur; both intellectual technologies as well as hardware technologies?

Another focus might be on consideration of the industrial markets of the future. I think the notion that we are going to have a world of abundance in the year 2,000 is fallacious. History has shown that as our ability to acquire material goods has risen, so have our aspirations. Recent studies, for instance, by the National Planning Association in trying to cost out the dollar cost of the National Goals Commission in 1960 indicated a gap of some 150 billion dollars between our nation's ability to realize those goals and our resources. These goals are very minimal compared with the goals we would like to have. An identification of the industrial markets of the future might be another aspect of industrial arts. For example, one market of the future would be the enhancing of the quality of our environment, the current emphasis on air pollution and water pollution is a specific example. There's an industrial market in these areas of hundreds of billions of dollars and probably 15 or 20 years from now will constitute a very significant portion of the gross national product and employment.

Another area industrial arts might emphasize is in making citizens more aware of the ways in which change can be effected. Dave's comments about the test ban treaty is a good example. Better informed citizenry certainly has provided major impetus in the current attention on the quality of the environment.

DAWSON: We have implied that if industrial arts develops a content which is acceptable, it probably should be thought of in terms of being appropriate for all--girls and boys, regardless of their objectives in future life and regardless of their mental ability. I would like to suggest it should be for all people regardless of their proposed future goals. I'm thinking here of a very simple, explicit idea--the doctor or the lawyer who cannot use terminology concerning technology cannot talk effectively with his constituency or with the people with whom he works. It seems to me that the ability to discuss facts and issues and people's jobs, what they are doing, is sufficiently important to be an objective of industrial arts. This is a part, I suppose, of the technological literacy that has been mentioned several times.

MULLER-THYM: We are moving, not very rapidly, toward some kind of equality between men and women in the work force. I go along with you that it ought to be for all, for the understanding of the whole process in which we are all involved. Let me raise a question, if I may, about the goals or content and needs. To raise my question, I will have to make a positive statement. One of the things that has happened in our world is that we have changed business in our society from having been a closed system--one in which output was equal to input and one which was a wealth manipulator in our society to being a wealth creator and a system in which output is greater than input. Now all classic economics and all industrial concepts view business in its former role. Profit is the reward which the entrepreneur takes for exploiting adventure. And in running his business he does not create any wealth, though he is an instrument of a big national wealth-creating machine. In that kind of world, which in economics corresponds to the universe of Galileo, Descartes and Newton, there is a certain finite amount of this they can call wealth. In this view wealth can neither be created nor destroyed and classic economics is concerned with the mechanisms by which it is reallocated in different size packages, as classic physics is concerned with energy--the way in which it is transformed, the place it is located, and how to describe the process itself. But the only new kinds of wealth come from nature such as agriculture, husbandry, and inventions. Until our day invention has been a work of accident.

Now in the classical world, value is added by production. Production meant all kinds of people beating things, hitting them, sawing them, storing them, pulling them from one place to another, and doing all the things which used to be the content of what used to be industrial arts.

In our society today wealth is not created in this way. Wealth is created by entrapping intelligence, as in research and development departments. One injects risk and imbalance into an otherwise balanced system. Also by marketing, which is the process by which things are brought to the market place. In that moment, which is only a moment, wealth exists. There is a transaction among men. This is a description of the world in which we live, even though it's not in Samuelson's book. Now this begins to be pretty powerful stuff because it involves some understanding of economics, some understanding of the history of science, some understanding of the structure of the business world, and things like this. The industrial arts are always right smack in the middle of it. They both affect and are being affected by it, but the meaning of their role is different today from what it was prior to 1950. Now I can see that in an industrial arts program, let's say in a high school, such as New Trier, north of Chicago, the question is whether one should deal with perpetual issues like the ones I just mentioned. I don't think we have to do it, if we have a good program. Maybe this is something that ought to be introduced in a university. But this is just a question I am asking--just testing the limits.

BRENNAN: This is a question we have raised among ourselves and we hope we can face up to it if it comes to a finite answer. Is it necessary? Is industrial arts necessary in the school program of today and the future? You made the statement that you were not certain it was necessary. Maybe this is something that we might be able to contribute to the future thinking in this project. You see, if we were to decide here and now and we had valid reasons for making the decision, that maybe we shouldn't have industrial arts. As you pointed out last night, this might be the deathnell for it. And maybe this is what it ought to be.

MULLER-THYM: My own thinking, just to make it clear, is not going in that direction, Tom. It could very well be that in a program in a university preparing people to teach industrial arts you should carry the discussion of the question I was raising to some depth. But not with any implication this would become part of the content of the stuff that they, as teachers, would in turn teach. If they answer the question in the strict sense and are honest--have the integrity we think they should have--in their answers, very probably it would enhance the program in the final analysis. Much more so than if they just accepted without question.

ALLISON: You have assured me, Bernie, and so has Bill Drake, that the industrial arts program I imagine should be an essential part of a high school program. I say this for the following reason: The matter of change, and the question: should this or should this not be part of the program? suggests to me that through industrial arts we can introduce uncertainties to the youngsters. I mean this: So much of what is now taught in high school suggests to the student that the problems have already been solved and here are the answers. A creative program in industrial arts should teach that the problems have not been solved; in fact, in some cases, we don't even know what the problems are!

Such a program is much more difficult to teach but, for that same reason, it is a much more valuable part of one's education than a traditional program, a program whose answers have already been worked out.

DRAKE: I was interested that Bernie used New Trier as an example. That was my high school and I might mention an experience I had there which did a good deal to shape the following two or three years of my life. It is an experience which I think is very parallel to one which might occur in an innovative industrial arts program. One day in a physics class I came across in the textbook, a hydraulic ram--you're familiar with what that is--it's a way of using the momentum of water to raise water. I did not understand too well how it worked so I decided to build one, which I did. Finally after about 6 months, it worked. Then I started asking myself a whole set of questions like why isn't everybody using a hydraulic ram? Why do we have pumps when hydraulic rams don't use any external energy? They just use the wasted energy, the momentum of water, to raise water and to create power. This got me thinking on a whole different set of ideas about what were the economics of building a hydraulic ram as opposed to having a small electric motor and pump that would accomplish the same thing. It turns out the small electric motor is a lot cheaper, including the power, than building one of these massive hydraulic rams. An innovative industrial arts program might well provide the opportunity for a student to take a particular product that he has made and trace it through the industrial process to the marketplace. An experience like this could get directly at the heart of the process of innovation.

BRENNAN: This is done, to some extent, Bill, in a well organized program of industrial arts where they have men experienced in production. The students analyze a situation ahead of time, make a plan, select several prototypes, eliminate the prototypes according to certain criteria they develop, make the product, go through all the operations of making it, and then try to sell it. They even incorporate companies, sell bonds and so forth. This is already in the program.

DAWSON: There are many kinds of industrial arts programs today, ranging from the old manual arts to research. What has been said reminds me of a program at the University of Maryland, which has been implemented throughout Montgomery County, Maryland, and I think Prince Georges County, Maryland, and some of the northern Virginia counties. The industrial arts approach at the seventh grade level is an anthropological approach, where the students study mankind as he has developed. Students study the characteristics of each invention, and how it was applied, and relate it to the same type of application today. For example, if you had a certain type of pump used in the Indus Valley two centuries ago, we may use somewhat the same principle today but with a different driving mechanism. A centrifical pump could be the same type of instrument yesterday or today, whether driven with a foot pedal or with an engine, or with some type of power source.

DRAKE: This approach would help indicate some of the determinants that are causing industrial change and why the pace of innovation is increasing.

DAWSON: You are saying, Bill, what I have been saying for many years. In the field of agriculture, for example, where has the inventive genius been? Let's say in the promotion of better crops through fertilization, or rotation. Or the production of farm equipment? Much of it has been in the educational system, hasn't it? It has been in the colleges and universities. What we are implying here, it seems to me, is that people in industrial arts should be thinking ahead toward the future--what is going to cause a change in industry or the area of industrial technology. And if we could build this into the educational system it would have a tremendous impact on what happens in the future and in preparing people for the future technology.

DRAKE: Yes. However, I am not sure that it's going to have a tremendous impact on what will happen but it will give the student a better understanding of what is going to happen and why it is going to happen. My own feeling regarding industrial innovation is that better than 50 percent of the innovation that is occurring is within industry itself. In many ways the universities are lagging. Many of the industrial firms are way ahead of the engineering colleges. In my opinion universities have not been very concerned with the process of innovation.

DAWSON: Is this because they have a different objective too?

DRAKE: Given the objective of studying innovation, I think many of the universities' approaches to industrial innovation are extremely naive.

ALLISON: The problem every engineering school has, *every day*, is, I suspect, the same problem as pertains in the industrial arts: an engineering education program must continue to renew itself and its people. Faculty people in engineering tend to become too academic; thereby, they lose touch with the world of engineering; those who are taught engineering are often *not* taught by those who *do* engineering.

MULLER-THYM: I think the same problem exists in business schools too. They are taught by people who have never been outside a business school.

ALLISON: A little story here might help explain what I mean. Years ago, in the early part of this century, in Budapest, there existed a school which somehow succeeded in producing at least a dozen of the greatest scientists and mathematicians who have lived in the 20th century. Leo Szilard went to this school, and Theodore Von Karman. Eugene Wigner went to this school. Edward Teller went to this school. These boys all lived nearby, but it appears this was not just a lucky stroke of fate. Rather, it seems to have happened because of two things. One, those youngsters received very strong training in mathematics. That's relevant to my point. Second, there was a flow-in and out of that school--of people from the world of science. A prominent Hungarian scientist or mathematician did not stay away from this high school--he would *teach* there for perhaps a year or so. There was a flow of people--in and out. The faculty was not the same from one year to the next; the school was able to draw upon some of the outstanding men of that small country. If that kind of spirit could prevail in the United States, not simply in industrial arts but in all education, we might gain what the Hungarians gained. (You know, Theodore Von Karman, who was one of those students, describes the Hungarian as "a man who goes into a revolving door after you and comes out ahead of you!") I like the story of the school because the odds against its success were so long, and yet it did succeed remarkably well.

BRENNAN: Your remark really incorporates a suggestion to the University, doesn't it?

ALLISON: Yes it does. I keep asking myself, who are the industrial artists? Those are the people you should be educating here.

MULLER-THYM: Incidentally, Arnold Ross, who is head of the mathematics department at Ohio State and was brought there to fill a gap, does just about this. They try to have a strong resident faculty and the sign of how they are succeeding is the way graduate students flock there--they can't keep them away. But what is happening because most of the mathematicians, the great ones, are attracted to the possibilities. Let's say one is on his way from Harvard to Stanford to give a set of lectures for one term. He contacts Ross informing him he could come by there first term--as a guest. I met one like that last February who was there to give a series of lectures. This is fairly a rare thing--to have a man, a top man, there just as a kind of gift, an accident, for a term, on his way to someplace else. It's the same formula, I think.

BRENNAN: Would one approach to this be a program of faculty cooperation like the cooperative programs in some engineering schools where a part of the year the student is in industry working and the other part he is in school? Would this be a feasible situation--to have the faculty go out a year and work in the industry to keep up to date? Would this overcome the lag that you were indicating there, Bill?

DAWSON: You'd have to specify the kind of work in industry, Tom. This is where industrial arts could either advance rapidly or retreat toward traditionalism. Guidance and evaluation would be exceedingly important.

BRENNAN: I would like to qualify the term industry. Maybe this might limit us if we keep thinking in terms of industry. We need to go beyond industry.

MULLER-THYM: I'm willing to wager that when industrial arts was first conceived it did not include any of the technologies of processing information.

BRENNAN: No, I think you're right.

MULLER-THYM: And yet at least half of the work of our industrial establishment does consist and is dominated by technology processing symbols. Now it follows the same design assumptions of technology processing materials.

BRENNAN: This is the point I was making. Originally industrial arts was built around a job analysis of the industries as they occurred at that time. A carpenter's job, for instance, was analyzed into its various components and courses were set up. At the time they didn't consider such a thing as a processing industry--the kind of an industry or technology that you are indicating.

MULLER-THYM: The only chemical plant known to the ancient media of the world, in fact up to the 19th century, was wine making.

BRENNAN: The point I was making, though, is that the people in industrial arts did not accept this in their definition of the term industry. At least not the type of an industry that was brought into the school--let's put it that way. Consequently, we settled on what we had and tried to embellish it. And we have come to the point now where we have excluded probably three-fourths of what really is industry. But is the word industry itself too restrictive? Is the term technology less restrictive? Or what term should we be using to determine the content area? Industry is rather restrictive, isn't it?

DRAKE: I agree with you. I think the term industry, even when it's coupled with the term arts, just doesn't do the job.

BRENNAN: Even if you turn it around and say the arts of industry--you're still just as restrictive.

ALLISON: No, it must be the technological arts. When you talk of industry, you miss all the industries that do not yet exist. The pollution industry, for example, which is just being born, and others that we haven't even thought of yet.

DRAKE: Could we use industrial innovation, or technological innovation?

MULLER-THYM: That's all right as a part of it. But there is a part that is non innovative in character which I want to be teaching also. You and I are for innovation, certainly. But they are talking really about the management of resources.

ALLISON: Or management of stock or capital?

MULLER-THYM: Yes. And innovation is, I think, part of a total process. We could talk about how one organizes, what are the central problems of organizing a productive array? These come down to management of space, time measurements which is concerned with dollars and things to work on, the productive capabilities and information. We need to make a generalization of this sort. But innovation does not have to be going on, even though it is desirable that we innovate.

DRAKE: Yes. I see what you mean. I don't have a good label for what that is, but it seems to me that facilitating adjustment to change is in the ballpark. Particularly change brought about by industry and society's pressures on industry, such as the creation of new public sector markets and the forces that sway industry in one direction or another. There are some industrial patterns happening now that really couldn't have been anticipated 3 or 4 years ago. I am referring specifically to some of the major companies such as the Ford Motor Company, which has announced they are going to embark upon a program to hire the unemployable. They have committed themselves to hiring 5,000 unemployables from the Detroit central city. One of the first things they are doing is taking a very very hard look at what their criteria for employability are. Is it really beneficial to have 1 year of college rather than no years of college? Or 3 years of high school rather than 4 years of high school? The arbitrary criteria they have used in their selection process in the past may not make sense. The point that I think is surprising, and very interesting, is that here is a company that is committed to making as many profits as possible. This effort is costing a good deal of money but it may well be that Ford Motor Company will maximize its long-term profits by this strategy. This is already directly reflected by the fact that they've gotten probably 5 times the value of their costs in terms of favorable publicity. Now why has this happened? It's happened because society is changing and is becoming better informed. 50 years ago if a company had announced that program, the majority of society would have said, why the hell concern yourself with that? The stockholders would have reared up and said, "You're not maximizing profits." But now they are maximizing profits.

ALLISON: Well, old Henry Ford and the five dollar day. That was pretty radical.

DRAKE: There are other companies in the Detroit area that are doing the same thing. J. L. Hudsons Company which is a clothing and distribution outlet has committed itself to hiring 500 previously unemployed people. This to me is even more profound and startling, because these people are going to have to be dealing with customers--directly--the public. They are going to be sales personnel, and the effort, the energy, the training which will be required is massive. I guess one thing that I'm saying is that industry, in many ways, is reconstituting itself and is another factor that might be considered in industrial arts.

BRENNAN: From what you have been saying so far, it seems to me that you're posing almost an insurmountable problem for a university that undertakes a teacher education program. If we had a Dave Allison, and a Bill Drake, and a Bernard Muller-Thym, all together in one person, he may be able to be an industrial arts teacher according to the concepts that you are putting forth here. You are implying that they will have to be systems oriented, cybernetically informed, have some knowledge of economics, and certainly a good basic humanistic background. What I am saying is this. Is it feasible for us to embark upon a teacher education program with the goal to produce a teacher who reflects the competencies in the areas you're saying ought to be reflected in an industrial arts program? Is this possible?

MULLER-THYM: Part of the magic that Dave was talking about is here. If you are going to conceive of a curriculum which is organized the way the classic curricula are, by fields, areas of specilization and subject matter, proprietary interests of teachers in such fields and so forth, then you're defeated from the outset.

BRENNAN: I think we've come to that conclusion ourselves.

MULLER-THYM: Yes, but you don't really have to be. There's no reason why there couldn't be some kind of a program where you would build a very enlightened, free wheeling, capable professional staff, probably small in number. The way we are moving in offsetting adult managerial education is away from fields of learning, courses, subject matter with boundaries around it, in which you develop by proceeding from A, by addition of B, then go on to C. This is a linear approach, a sequence system. The systems approach is organized around ideas. Around the section in the center, massive inputs for short and significant periods of time are implemented. The technique is very much like a technique in surgery, where you have a complete area that has been, let's say burned, or has to be treated. Instead of taking a big slab off the back of your leg and attaching it with the hope it takes, you simply clean all the areas down and then take little tiny islands of skin and plant them about a quarter of an inch apart. If any one of these takes, the whole area will be recovered. Or if two of them take, it will be recovered in half the time. That is the reason for the approach--both to decrease the length of time and to increase the process of healing. Learning takes place by leaving it to the intelligence of the individuals--it will fill in just the way the skin does. If you combine this with Dave's suggestion, it would be possible for a Dave and a Bill and a Ken to come and work with students in a situation similar to this conference for 2 or 3 days and talk and discuss freely and organize and talk again. Possibly the same person would come back a month later, so he might have visited 3 times, let's say. I think you could do things this way. And then you could pick out some things the students should be reading during this period in any order that they choose. I think you'd get the effect you want.

DAWSON: I think what you're saying, Bernie, is something like what we have been saying for a long time and it sounds almost too simple to even mention. In industrial arts we have great thinkers and great teachers. We have people who have worked harder probably than any other group of teachers. We have had people who have been very dedicated. But the good thinkers have been so busy with details they have not had the time to sit down and think how to move industrial arts forward, year by year. We in industrial arts are way behind in the thinking process. Now that's exactly what we are doing here--just thinking together, which is good.

MULLER-THYM: Now we have massive inputs from disparate sources.

DAWSON: Industry has great numbers of thinkers and time to think. Take a look at the money industry puts into education. This year industry will probably put somewhere around 40 billion dollars into education. Industry will probably put more money into education than all public and private education--kindergarten through higher education--in this country this year. If we could bring into West Virginia University three or four outstanding minds who had time to do nothing but to think, it would pay rich dividends. They would need to be involved with other people who can reason effectively--to rub minds one with another, within the university, with other universities and with industry and scientific and educational organizations.

DRAKE: Wait a minute. I misunderstood because I thought what you were saying, Bernie, was to have a "floating crap game." I thought you were talking about different people coming in for a day or two. I think that's an interesting idea.

MULLER-THYM: I'm not looking for a sabbatical or getting someone to come here. That's a possibility also but I think there's much more to it.

DRAKE: It seems to me that people who go to Ohio State don't just do it out of the goodness of their heart. They do it because they get something out of it.

MULLER-THYM: They do it for association--to be someplace where something is going on.

DRAKE: Yes, what I'm leading to is the need for a "carrot." And I suppose there would be a variety of "carrots" you might use. It probably wouldn't be money. One "carrot" you might use would be a well designed and controlled experiment. Something in which the outcome, even if it were on a long term basis, could be measured. Let us suppose you had a crop of industrial arts students who were exposed to this program over a year's time, and then went out into the teaching world. And you had some way of monitoring what the effects of that group were as opposed to some control group. The problem of measurement criterion is in itself an interesting question. I don't even know how you would begin to answer that question. It's an interesting problem, though.

DAWSON: I believe the type of thing you and Bernie are talking about, Bill, is not fast enough. With the rapid pace in education today, I don't believe you can have people coming in, even once a month for two or three days to perform the service education has to have.

MULLER-THYM: I wasn't talking about one person. You design something that is going to run for a term. This is plenty time for what I'm talking about. In the course of that time you might have had 10 different people who are working around what I call mobilizing ideas. I don't know of any way to get a given amount of learning done in a short period of time that is more efficient than this.

BRENNAN: This is the technique I used to teach that course in federal legislation. I didn't know enough about it, so I went out and got 5 different people. They came on a weekly basis during the five week course.

MULLER-THYM: Let's take two groups of men, comparable in age, level of achievement, and other factors. One group takes a six week course in an executive program, as described. Compare this against what the other men get who attended a year at the Harvard Business School.

BRENNAN: This presupposes that you have a receptive student, also. This brings up a very salient problem we have in recruitment. If you are recruiting right out of high school, he didn't come out of an environment similar to this. You have an adjustment period of getting him into this approach. You also have a loss of population somewhere along the line. The regular attrition that you normally have would be evident plus, I think, a greater attrition.

MULLER-THYM: Let me incidence on the other side the way the world is rigged in your favor. The odds in our type of world are that you will succeed rather than fail. The kids coming out of high school live in an environment that is completely changed--it is electronic. Most of their associations are oral. They will travel for blocks across the city to get together and do nothing but talk.

DRAKE: Or use the telephone.

MULLER-THYM: Yes. It's been pretty well established that we talk on the telephone most to those we see the most. However, you have no experience of working together--you can't work over the telephone. So, because most of the associations that I'm talking about are basically oral and electronic in character and because that is the nature of the world in which we live, you are doing something which is hip or current, rather than archaic. I think it's set up for them to respond even though their prior experiences do not prepare them for it.

HALES: I can see a problem in this because we have a system now in education. What we have proposed is fighting the system, which is fine. But it's going to be extremely difficult for a student to work within the existing system and all the other disciplines that we impose upon him and turn himself on and off as he comes within our area.

BRENNAN: It might be more difficult for the University itself to tolerate this kind of thing.

HALES: The University has to tolerate it but I can see the student having a difficult time even though he has extreme flexibility and adaptability.

DAWSON: If we are talking about a new type of education, and if we are talking about a new type of industrial arts, as we have been with the new type of math and new type of social studies, and new physics, it seems to me that we are going to have to expect all kinds of educational innovations. Now we are talking about what is going to happen in the future when we cannot, today, handle all the students who will be in school. And we're talking about teaching thousands of students in one class, rather than 30 or 40. We're talking about small group discussions and about individualization of the education process. Almost anything, I believe, that has good rationale behind it is going to be acceptable in the future educational program. I would hope that sometime before we finish our discussion we could bring our thoughts around to two points. One would be the terminology or the name which we think should be applied to this subject field, and secondly, what is the domain of industrial arts? Is it industrial technology? Is it something else? Is it industry and technology? Is it the applied arts? Is it the scientific arts? What is it? These people are going to need our thoughts--before they go much farther.

BRENNAN: We have some ideas. Paul will give them to you tonight. Admittedly they are prejudiced. We have arrived at them because of our own bias. We certainly would appreciate it if you could define the area of knowledge which is industrial arts--if we use this term--or whatever term we give it. I'm using industrial arts because we don't have any other term. If you could tell us the sphere of knowledge from which you would draw the content, from which we could draw the content, this would be of inestimable value. And then if we could get a name that you think is descriptive enough, this would be helpful. You don't sell a product if the name isn't descriptive.

ALLISON: The name that works, at least it satisfies me, it tells me something when I listen to it, is the technological arts.

BRENNAN: This is not really definitive enough, in one respect.

ALLISON: Walt Kelly said, always be a little vague. Don't be too definitive.

BRENNAN: Maybe we ought to have a differentiation in technology itself. Certainly I don't think we want to go into, say, medical technology, for instance. You see, this is a realm of its own and it's fairly well staked out. And I don't think we'd have much chance of getting into this whether we'd want to or not. Maybe we ought to think in the realm of physical technologies, as opposed to medical technologies. You see the point I'm making is that technology itself is an extremely broad term and would need some definition so that we could have a definitive name.

ALLISON: But if your concerns do involve man's interaction with his environment, then you are going to find it necessary to involve some of the life sciences in your discussions. And therefore I wouldn't draw the boundaries too sharply.

BRENNAN: Let me give you an example on the other extreme then. Suppose we did say technological arts. There is such a thing now as cosmotology technology. Is this the kind of thing we want to include? The term technology has become a rather loose term in common parlance today.

ALLISON: Well there are a lot of things that go into science too, things that are not science in the strictest sense. But that doesn't mean the word is bad.

DRAKE: I think we must somehow introduce the notion of change. We can't think of our environment in static terms. What bothers me a little bit about physical technology is some of the things that Bernie was saying here--that half of all industrial effort is now information processing in one form or another. The largest technological growth is in these areas.

MULLER-THYM: I have a real conviction, generated by our talk, that in such a program there ought to be one subject or course on the history of technology, whatever that might be. Now if we can go back to your somewhat too sharp and somewhat too vague statement of last night about the sciences, the humanities and the technologies, I think we can find our base. What we're really concerned with and what distinguishes technology is the rationalization of some kind of process, a process of dealing with the world and exteriorizing man. It differs from a science, or from theoretical physics, which is not concerned with this at all though it may be an input type of knowledge which may generate it in turn. But we really are concerned with what Francis Bacon called command over nature. This, though not a good word for it, makes us magicians in the classic sense of the word. It kinda ties in with our keynote talk of last night. It goes back to this. I have a certain amount of freedom in my work. I enjoy it--it's kind of a free-wheeling sort of place. One of the nice things about it is that it's a modern university founded with science and technology, although science occupies a relatively low state. What we really are is the brain center of magic. Now you say this and inevitably someone says, "Bernie, what do you mean by that?" And I say, "Let me give you an example." Science is that branch of knowledge which is concerned with command over nature. One of the tests of whether you're a great magician or not is whether you can achieve the intended effect with assurance. The test of this is replication. So if you say I'm going to do something and it happens, and you can do it the second time, then you're a real practicing magician. Then they asked me to give them an example. And I say, "To give you an example, we've asked everybody here to qualify in basic vodoo." That's all right with 90 percent of the audience. But surely there'll be somebody around who'll say, "Bernie, what do you mean by that?" And I say, "Vodoo is that branch of magic in which one changes the intended effect by constructing a model and manipulating the model." It's really a matter of snobbery. The people who do it with mathematical models look down on people who do it with clay models. If we call ourselves instruments of technology, and if this is our mission, then it is very clear. We are all concerned with how you make something happen and bringing about change is one of the most difficult of the magical gamuts in which man can engage. Now you can see that we are in command over nature. You're always dealing with how you can bring about an intended effect. Technology is concerned with this whether we be concerned with how we fabricate, how we erect, how we construct the very simple artifacts made out of clay, plastic, nitrogen and the rest, or whether we're concerned with the construction of more complicated artifacts like cities, or weapons systems, or missile systems or the organization of a group effort. This is the whole domain of human activity--basic human activity. It's the way that man is engaged in building and making more complicated the environment of the world; calling into existence orders of being that have not been there before. We are most concerned in our society that we've learned how to make very simple types of things like razors and automobiles, as well as the design and construction of systems. That is what our attention is focused upon. This ought to be part of the history of technology too. In doing this, I can see a whole cluster of courses to establish. At least one of the organized courses would be in basic technology. This is a way of backing us into a name. If you want to call it a course in "man and his extensions" you might not be too far off. What you are doing is proposing this as an exploration of what has been one of the classic dimensions of human activity, as science is another one, as philosophy is another one, and the humanities another one.

DAWSON: Suppose we settled upon a name like Technology. You've already given us one weakness of that, of its breadth.

DRAKE: It has worked for MIT.

DAWSON: Yes, it has.

BRENNAN: What about the engineers. I am not trying to shoot them down, I am trying to react in the same way my contemporaries at the University might react. If we set up a division of technology, would the engineers be concerned?

DRAKE: They probably would.

ALLISON: They ought to be involved in that division.

MULLER-THYM: I think it would do them good to understand that the basic way most of them go about doing things represents a fairly small fragment of human experience.

BRENNAN: We are pretty much convinced that it is essential for the future engineer to be exposed to this. From this standpoint, if for no other reason, the contemporary college engineering programs ought to be concerned about it. They have a stake in it. We think that because there are some very definite aspects which involve the world of commerce and so on, that the commerce people should have a stake in. Of course we could get into this because we would involve these people. We could have them teach courses in our discipline, you see.

DRAKE: Is your product high school or secondary school teachers?

DAWSON: And elementary teachers.

BRENNAN: We don't know. We are thinking of a teacher education program or it could very well be a division of the College of Human Resources and Education.

MULLER-THYM: I'm trying to relate myself to a couple of your inputs here. You remember at the end of the second act of "The Skin of Our Teeth" the old fortune teller comes out to the center of the stage and watches this bunch of men go by and says, "This one is going to die of cirrhosis, this one is going to die this way," and then she says, "Oh, anyone can fortell a future, but who can fortell the past?" Well, to get back--the kids these teachers will be teaching, either in primary or secondary school, will have been, by the time you get them, already in things like the life sciences. By the time these teachers who you are going to train start doing it, who knows what will be in there. The stuff that is in the works now is fabulous. So the odds are very good that the kids will know more than the teachers, unless you do something. This is an interesting switch. Now back to the comment I was about to make. If you begin to think of the elements of a program where it would be a master course in the history of technology, or history of work if you want to call it that, then you'd need, let's say, a course in systems. Now this is not a course in systems abstraction that would appeal to the level that Ed is operating at. It would be something like a natural history of systems, where you would begin to teach and understand the systems characteristics of organisms or what the systems characteristics of a thing like Polaris are. You'd have another course in the management of change. And again you start out with a lot of examples. Then the generalizations, observations, and so forth begin to appear as a function of the examination of the examples. Salesmanship, for instance, is very valuable for both systems and for the methodology of bringing about change. These are three courses for the program, in which anything that you knew as already valid from industrial arts education would be applicable. But, and this is very important, it would have a completely different kind of intelligence in the format.

DRAKE: One possible course would have as its goal an anticipation of the kinds of requirements that society is going to impose on them 10 years from now--a speculation in a sense, but a speculation with some reality. There would be opportunity for many rich examples. The problem would be to conduct the course in a positive manner so that it doesn't become a threatening experience that causes just the opposite of what you want, namely, an opening of horizons rather than a threat or a fear or concern about the future.

ALLISON: I don't think the arteries begin to harden until people are a little older. I don't think the student will be as frightened of the word "change" as perhaps we are. The young person is able to ride with it, accept it.

BRENNAN: Our threat will come at the graduate level.

DRAKE: I think it has all kinds of implications for the kinds of decisions they make. It's a guidance program--but not vocational guidance. It's a life guidance in a sense--it's a future guidance.

ALLISON: It helps them to see opportunities. That reminds me of something I wanted to say; it may make the problem more difficult than it already is! It is inherent in the word "change"--and I think it should be inherent in any program of industrial arts--such programs should be open-ended programs. The student should know, as he is being educated, that education doesn't stop after a certain number of credits or years, but that it must go on. Now this puts the responsibility on the educators, and on all of us, because it's not enough simply to say, "Your education doesn't stop after 4 or 5 years of college." It puts a responsibility on all of us because it's incumbent on society to make it possible for that education to continue. I'm not thinking solely of the college graduate who comes through this program. I'm thinking also of the man who works on the Ford assembly line, mingling with 5,000 "untrainables," that Ford has hired. Somehow we must provide a ladder for continuing education for 2 hundred million people--not simply the college graduates or the graduate students. As this nation becomes more productive and the work day becomes shorter, somehow we must make retraining--or whatever one wants to call it--available and possible for anyone who wants to take advantage of it. Not as night school, but as part of one's daily life.

DAWSON: We have been laboring, I believe, under the assumption that industrial arts was basically for secondary education. I would say industrial arts is now more heavily weighted in the junior high schools. At one time when industrial arts began, it was largely elementary. Then it went from elementary to senior high school and back to junior high school. I like the idea you expressed, David, that industrial arts, just like any other subject area, has to be involved with a lifetime process--with adult education. I believe this nation is just beginning to get involved in continuing education. Industrial arts could well be one of the greatest courses in a continuing education program. But it has to be something different than the type of continuing education program industrial arts has been involved in in the past where you get doctors, lawyers, nurses, and so on who come in and simply want to make something in a laboratory. We haven't begun talking about the type of place where this is going to be taught.

BRENNAN: I don't think it is germain right at this time. Once we define what it is, what the content is, I think there's enough smart people around in this world to devise the laboratory or the place to teach it. I am much more concerned at this stage of our thinking in defining the sphere of knowledge we are going to say is our content area, and then the name, if we can get that. We really are playing all around this name, Bernard, and we really haven't backed into it yet, have we?

MULLER-THYM: The Division of Technological Change?

DAWSON: Innovative Techniques and Technology?

MULLER-THYM: Something like Man and His Work--Environmental Resources--Man and His Work--that's interesting.

BRENNAN: It has a definite connotation of science.

DAWSON: We have to make sure we don't encroach upon another course which is already in school, but we must not leave a void between industrial arts and some other work.

BRENNAN: We have been through this ourselves. We've come up with some of these same ones. We've discarded them--not because we had a better one, but we just didn't like them.

DAWSON: A few moments ago David mentioned the technological arts. I think we've been in trouble for 65 years in this field because we used the words industrial arts. Not because industrial arts could not be a good name if we had done a good job in the field or if we had promoted it properly. I think there was a compromise when the word industrial arts was used. I believe changing manual to industrial but maintaining the arts was a disservice to this field, because the public and school administrators and others have never understood this term. The dictionary definition of the word technology is the "systematic knowledge of the industrial arts." But we have not been able to convey this to the public, that industrial arts is closely related to technology.

DRAKE: Industrial technology?

DAWSON: This is the term that I have been getting closer and closer to over the years. Whatever we do has to be open-ended enough so that we can go to the year 2,000 without getting into trouble.

BRENNAN: Maybe the word technology is open-ended enough. The simple word itself--technology.

MULLER-THYM: But it's the word industrial that's bugging us. Because it's this word that was meaningful in 1900, but it doesn't mean the same thing today.

BRENNAN: No, and in another 10 years if will probably mean something else again.

DAWSON: But what is another word that we could put with technology? If we should have another word that would imply the things we are saying in the area of industry, to delineate between production technology or what have you, and the other types of technology--we might have our answer. We cannot be all-encompassing.

DRAKE: You want to include information processing technology, don't you?

BRENNAN: Yes, very definitely.

DRAKE: I'm in favor of introducing in the term the notion of change.

DAWSON: Emerging Technology? Technological Change?

BRENNAN: He's talking about the management of change itself.

DAWSON: You're talking about producing change.

DRAKE: Yes, and being able to live with it happily.

DAWSON: We can't use the word Applied Technology then.

MULLER-THYM: Technology is applied. That's the hang-up they have in the Bureau of Standards.

DAWSON: We can't use Applied Science.

BRENNAN: What about Technological Change?

DAWSON: Could you live with it?

BRENNAN: We learned to live with industrial arts. We came into it without questioning it. After our generation is gone, if we settle on this, nobody else will question it.

DRAKE: I think that fits your course, doesn't it--Technological Change?

BRENNAN: It clearly does. But only against the background of this conversation. We know what we're talking about. But I don't think it would pull anybody else in.

DAWSON: What does it do to the parent of the little fellow who is 12 years old and going into junior high school?

ALLISON: God, the word technology itself is going to scare him.

MULLER-THYM: No, I think he's going to love it.

DAWSON: I think he'll buy that, the word technology. But it depends on what you put with it--whether it's good or bad. Maybe we should just stop with technology.

MULLER-THYM: Now technology doesn't bother MIT at all. Industrial does, and they've changed the name of one school from Industrial Management to Management.

BRENNAN: Maybe this is our clue. Maybe we shouldn't use any other label. Maybe it's enough--maybe it's open ended enough; maybe it implies enough.

ALLISON: Then you are the engineering school. What is technology--a high school course in technology?

BRENNAN: We get into all kinds of problems with engineering technology, industrial technology, cosmotology technology.

ALLISON: Traditionally we are teaching the activity of man in the same way we're engaging in contemplation.

BRENNAN: How about Man and Technology?

DRAKE: I had written down Technology and Man a while ago.

MULLER-THYM: If you're supposing that most of this will go on in a secondary school, should we be concerned with the development of the intellectual life of man? Here you are dealing with those knowledges and intellectual processes by which man has built things and changed their nature and their appearance. You have the physical and information technologies appearing all over the world as a result of this activity. You would study this as a chain of activity of man, either from the point of view of man himself and the process, or from the point of view of the design of principles employed in the artifacts. Also, you would study the role which has been generally economic in character but has been very closely related to the formation of wealth such as transactions--buying and selling--people getting paid for things. At least that is the way it's been for about 5,000 years. In dealing with the phenomenon of change, you are dealing with something that is common to all these things; the sciences, political activity, and technology. The industrial arts focus is with respect to how technology is affected.

BRENNAN: That would be perfectly appropriate.

DAWSON: Suppose you are Mr. Citizen and someone suggests a course called Technology in senior high school. Would this include some economics?

MULLER-THYM: Sure, if it is technology oriented at all. How can you separate them?

DAWSON: Would it include labor problems?

MULLER-THYM: I don't know.

DAWSON: What I would like to explore is the necessity of an understanding of the ramifications concerning technology or concerning industry, labor problems, economics, corporation management, and much more.

DRAKE: Yes, but I would be inclined to think in terms of the forces that bring about changes over time. This is the key question.

MULLER-THYM: I have a comment with respect to Dr. Dawson's question. You could come up with a course that would not be proprietary to the industrial arts program but could be a shared course with other disciplines in history or sociology and would be concerned with human institutions--political institutions, corporate or special institutions. I'll give you a two minute economic history course. There are only *two* important moments in the history of economics to date. The first was in the fourth century, B.C., when Aristotle identified the body of knowledge and gave it its name. He said there is one body of knowledge which is concerned with man if he lives in a large society, this is politics. There is another body of knowledge which is concerned with the life of man, the individual--these are ethics. Then there is another body of knowledge which is concerned with man as he lives in a society, but in a society which is smaller than the large society, and this body of knowledge is economics. He invented the word. The object of this body of knowledge is wealth. Then he added a page or two and it's done--he didn't say any more. But he named it after the household. The household in the ancient world was the only institution, prior to the modern business, that seemed to be economic in character. It tried to be self-sufficient, and pretty much was. It was the wealth creator in that society. Up until that time we had had a lot of economic type activity. Anything which multiplies and makes possible the enrichment of transactions of men is economic in character. Business men today make their really important decisions in terms of a kind of economics, that has not been formulated and of which most economists are not aware. Now I think we are, for the first time in the history of the world, in a position because we now have again a wealth-creating organized society where we can observe the wealth-creating process, in the moment when it occurs. In between, all we've had is a lot of parrot economic descriptions. For example, let us imagine a science of medicine in which the practitioner had never been inside the body but the whole body of practice was based on the affluety of the system. You would have observers with instruments at the mouths of sewers measuring the nitrogen content or the affluety of the gross national product. What do you suppose happens to our economists when we go through a routine like this? It's a measurement, but they are not measuring wealth formation. What I'm trying to say is this. If one could have a course in human institutions, a natural history that precedes political science, the household, labor unions, and so forth, I think such a course would be extremely valuable. It would serve your purposes as well as other schools in the university.

DAWSON: We have identified great numbers of courses that could be involved in the total program of industrial arts. We still have not identified industrial arts though, what we want it to be.

BRENNAN: We haven't named it.

DAWSON: The wisest thing we could do would be to avoid giving a label to any course or any program--English, history, social studies, or what have you and simply build a program with a series of courses which would provide an education for all youth which would not have the title of a single one of them. We would not say, you're an English teacher; you're a Science teacher; you're a Math teacher.

MULLER-THYM: You have a point. The people who voted the money in 1963 for vocational education did it in the expectation and the illusion that they were creating greater job opportunities in a world in which unemployment is certain.

DAWSON: I'd like to have a vote of the national population on that deal and see what it would show.

ALLISON: Let me say one thing before we close. When Robert Heilbroner had written "The Worldly Philosophers"--that was the title he wanted to use as the book title. Simon Schuster, the publisher, thought it a very poor name for a book. They wanted to call it "The Great Economists". But Heilbroner was stubborn and he held out for "The Worldly Philosophers". The publisher decided: we'll have a market test; we'll publish the book under both titles and try it out through the bookstores. Some bookstores received copies of "The Great Economists" and others, "The Worldly Philosophers." The book began to sell and, you know, it didn't make a damn bit of difference. It sold either way.

BRENNAN: This is the same sort of thing we've found in our study--that it doesn't make a bit of difference what a kid takes in high school to determine his success in college. Courses mean nothing.

ALLISON: That is the point! The book happened to be a good book, and that's why it sold.

MULLER-THYM: Donald Schon won only half of the title for his book, Technology and Change, because his working title had always been A New Heraclitus. The publisher persuaded him to use "Technology and Change." "A New Heraclitus" is the subtitle.

Thursday Evening
November 9, 1967
General Session
Dr. Kenneth Dawson, Chairman

DAWSON: Tonight our program is in two parts, plus an addendum. Dr. DeVore will make a philosophical overview of the program he and Dr. Brennan have planned as a base for industrial arts at West Virginia University. After Dr. DeVore has completed his part of the program, Mr. Haskill will make a presentation. Our discussion this evening will reflect on what both of these people say in relation to our overall objectives. Afterwards the recorders of the two groups which met this afternoon will bring us a two minute capsule of the area each covered. This evening we don't have to introduce either of these people to the group because we have been living with them now for 24 hours. I think I should say about Dr. Paul DeVore, however, that his mind is a wandering mind--it wanders wide, it wanders deep, it wanders far, it has wandered in considerable depth in the field of industrial arts. He found himself unsatisfied with the program that he was running when he was head of the largest, or the second largest industrial arts programs in the country, on the teacher education level. Dr. DeVore took a year off to do post-doctoral work at the University of Maryland, the Smithsonian Institution and in Europe. He spent considerable time traveling in the European countries trying to get some ideas on technology. He brings to us tonight great depth and background and we are looking forward to your report at this time.

DE VORE: The reason I'm making this presentation is to take advantage of your thinking. We are trying to do a job for West Virginia University and industrial arts teacher education in particular. We are searching for ideas and direction to a very complex problem. I think I find myself living with some ambiguity. I thought last night, as Dr. Micheels spoke, that I did have a foot in each camp--the essentialist position, which will be reflected in what I have to say tonight, and the existentialist, concerned with meaning, direction, and values of a curriculum area. My major concern which I mentioned to Dr. Ikenberry and Dr. Brennan and a few others a couple weeks ago, is that I don't desire to engage in a curriculum project as an exercise in futility or busy work. That is the reason each of you is here. And that is the reason I am presenting my ideas. We want your reaction to them.

Let's set the stage with a little background. There are a number of philosophies in the profession, ranging all the way from the manual arts to the industrial, to the concepts we have been dealing with today, this thing we call technology. The future is still in question. By way of analysis and background, I would like you to know some of the lineage. This material came from a friend of mine, Dr. Kenneth Brown from Buffalo. What this points up is the dichotomy between what we call vocational education and what we call industrial arts education. On the left side of the slide we have the lineage in terms of the ideas of the manual training concept which came from the Russian Tool Exercise System, Swedish Sloyd, and then on to an American synthesis of faculty psychology, and the manual arts movement which followed some of the industrial expositions. Some of the ideas developed as a result of the Centennial exposition, where England did not evidence good design. We became concerned with design and added arts to the name making it manual arts rather than manual training. The Smith-Hughes Act of 1917 gave us vocational training and because of this we still have today the idea that industrial arts serves pre-vocational purposes. This started around 1922. This purpose is still evident and in existence. The other side of the slide shows the general education emphasis with John Dewey and the psychology of occupations. Charles Richards in 1904 gave us our name--he called it industrial arts. Frederick G. Bonser provided a definition of industrial arts. Then we had a split at this point in time although both camps are speaking to each other. It is not a great philosophical split, but it is a difference in theme, a difference in point of view. One point of view says the major theme should be the interpretation of industry. The other major theme says it should be the study of technology and man, or man's technology. Both of these movements, by the way, came out of Ohio State University. This one was the laboratory of industry in 1935, while this was work at Ohio State in 1947. Both are related but different. My predecessor at Oswego, Dr. Wilber, published a book which dealt with behavioral psychology and the functioning of industrial arts in relation to the interpretation of industry. Dr. Delmar Olson published a book on Industrial Arts and Technology, and there are others in this area.

On this slide the three central themes I have briefly outlined. The content universe of the vocational lineage is from the mechanical trades. Its concept is European in origin and it is focused upon the village trades of the 19th century. Primarily as you look at these programs as they are in evidence today in our public schools, they are oriented to the past--hand skills, tool skills, and so on. The central theme is job skill and performance. The center of the slide shows the industrial arts lineage. This is American industry. It is American in origin and is focused upon the elements of American industry. It is oriented to the eternal present because it cannot go further than what is in industry. Its central theme is understanding the organizational operation of industry. The technology of man approach is also American in origin and is focused upon the study of man as the creator of technology and is oriented to the span of civilization. Its central theme is the relationship between technology and culture and the basic concepts and principles of technology.

I'll now move relatively quickly to cover the basic concepts. We are raising questions such as these. "What is and what is meant by the name industrial arts?" "What should and should not be a part of this field of study?" "What relationship exists between industrial arts and similar activities?" And the final one that has been suggested today, is "How do you evaluate what you are doing?" As we deal with this and as I see the problem, there are two elements. First, the problem has always been attacked as a curriculum problem. This seems to confuse the issue. I see it first as a determination of the content structure or the discipline structure. And then I see the curriculum problem. The two elements have two functions. The discipline structure is arrived at by a structural analysis which is primarily an organization of things. The curriculum structure is developed through functional analysis which relates to processes or types of activities. This is an intellectual activity and concerns the age of the learner, the types of learning environment, teaching processes, and etc. If this assumption is true, then it logically follows that there are two kinds of endeavors: (1) those primarily concerned with the discipline of technology and its structures, taxonomy, theories, and laws, and (2) those concerned primarily with the educational process or curriculum and its structure, principle, concepts, units of instruction, courses of study and learning environment.

As you look at this there are, then, two elements, the structure of the discipline as it relates to the educational process and the educational process as it relates to what can be taught. We have also brought up in our discussions so far the practical elements which McHale is talking about and are part of the curriculum. There are theoretical elements which are a part of this problem. These are tempered, from the concrete to the abstract, by the time you have to spend in the curriculum area, by the level of content of the material you are teaching, and by student ability. Therefore, it's possible to look at some of the areas we are teaching and say that a portion of the time, because of student ability, is given to theoretical work and that the major share of it is in practical, concrete work. As the student ability moves to the right of the continuum, we gain more insight through the theoretical activity and less through the practical.

In the application of this educational process, these are the two problems to consider. If we look at some of the work that has been done by different individuals in systems development, Kuhn's work, A Unified Approach to Social Sciences indicates that there are five stages to go through. The first one is observation. Professor Haskell and I have discussed this as it relates to his work in synthesis. Some of the work in industrial arts that is going on today is at the second stage, the classification stage. This is the structure stage. Here we try to identify the major elements. At the next stage you try to find out what the relationships are--the functional relationships between the elements. In the fourth stage you construct a theoretical model. Following this you move into a total system. These are the stages that seem to be called for.

I would like now to present to you a line of thinking, a line of investigation, which to me gives some answers. One approach is to identify those areas of man's formal knowledge that have been accumulated by him and are acknowledged by others. The primary breakdown is from Professor Ten-Hoor, formerly from the University of Tennesee, who is a philosopher. The major knowledge areas that man has created according to Ten Hoor are three in number. Now there are other ways to structure knowledge but he indicates that the sciences, the technologies, and the humanities are three major areas of endeavor. Each is different. Each raises different questions. He says that sciences, being a body of knowledge, raises the question; "What is there to be known about the external world and about those who live in it?" The technologies, according to Ten Hoor, direct their attention to the question; "What use can we make of the information determined by the sciences about the external world and those who live in it?" Some people say that the sciences determine what is, and the technologies what is to be. The third area of knowledge is the humanities. The question raised is what use ought to be made of the information determined by the sciences about the external world and those who live in it?" Here we enter into the question of meaning, value judgments, human beings, and the existentialist point of view. Using this line of reasoning, it seemed to me that the field in which we were concerned had only one area of study with which it could be concerned as a content area. This is the study of technology. So, I started to investigate this, looking at it in different ways, primarily from a historical standpoint. I came up with a number of central themes or what I would call major technological endeavors. Let us look at the slides in terms of man's creative endeavors. What has he created? Also I would like to preface the showing of the slides with the comment that you must consider technology to be a human endeavor. It was created by man so it has human elements, social elements and cultural elements that relate directly to it. One sociologist calls it "man's special power." Each area of endeavor I preface with the heading of man--because man created them. This is man the builder. You might relate this to the construction industries and the many creative endeavors in this technology. He has engaged in constructing buildings, canals and bridges. This permeates all though the history of man. As you go back you find what his technical accomplishments were in this area. We mentioned a subdivision of labor groups, rivers, tunnels. Another major area of technological endeavor has been man as a communicator. For a definition the phrase information dissemination, storage, retrieval and use describes the area. The technical means of doing this--smoke signals, semaphore, blinker lights, graphic arts, photography, and the more sophisticated communications gear of today such as computers. Man also has been a producer. He has taken raw materials, extracted them from the earth, and produced items for his use. Sulfuric acid manufactured 200 years ago, paper making in the 18th century, etc. What we are searching for is a theme. Another area of technological endeavor has been in transportation. Man the transporter. It is an environmental concept, a problem. All types of technical solutions are required in transportation which can be defined as man's method of moving himself, his goods, or his services from some point A, to some point B, in some specific environment by some technical means.

Man has been a craftsman. Individually he has engaged in many of the craft areas--pattern making, tool and die making and supportive areas for these different things. The prime function here, the focus of attention, would be on tools. Craftsmanship fits all of these areas as well as the next area, which is man the developer, the creator of new ideas. Research and development industries would be a prime example today--first as an individual effort, such as the Wright brothers, Bell, Edison, and others; then later, as group activities, governmental research involving highly complex and sophisticated methods and techniques. Another element which permeates technology as you study it which was mentioned by McHale this morning is organization--the group processes, the social functions. This is accomplished by group effort, the subdivision of labor, higher and higher levels of specialization, and so on.

This is one way of identifying some of the areas of study for the industrial arts. This is an historical and social analysis of determining some of the major themes that run through the history of man as he has engaged in different technical endeavors.

We have the possibility of considering it as a discipline area. I'd like to review why this may be. On the projectural I've listed a number of terms and phrases. First, we find it does have social-cultural components. Innovations and inventions and developments in technology do affect the social-cultural aspect of man. It is a form of human knowledge. It's different from knowledge in the sciences. It's different from knowledge in humanities. It's a determination of what is to be--it's a creative endeavor, a solving of problems. As Jarvie says, or as Skolomowsky says, it's identified by the character of thinking involved. That's true, also, of the humanities or the sciences. The technologies are definitely associated with tools and technology does affect all people in a culture at some time or other. But it is also a pragmatic thing--it's concerned with the possible. Schmookler, the economist, described technology from the economic point of view as the social pool of knowledge in the industrial arts. I have focused on these things because they are closer to what we are actually doing. Technology is a function of human behavior; it's problem-centered; it's activity centered; and it's environmentally centered. The technologies are unique to certain cultures and certain areas. This is true of transportation. The environment of water, the environment of air--we'll look at these later--are both different problems for transportation design.

If we approach our problem from areas of concern then the phrase, technological literacy, has relevance.

But in order to move ahead, we need to be concerned with identifying the areas of knowledge in the technologies. What is the structure of this area? The taxonomy? I've tried to indicate, through the historical slides, that there are some cultural universals, that transportation is a part of every culture, that communication is a part of every culture, and there have been technical means developed to accomplish this. What are the basic concepts? How can we reduce the mass of information to a manageable structure, the basic concepts, the common learning, the body of knowledge? What we may be searching for in this curriculum structure is something that has central themes, that has historical precedent, and looks like it is going to project into the future for some time and give us external stability. But we don't want to define it so tightly that we won't have internal flexibility and adaptability to change for the structure. For instance, transportation is apparently a stable function in a culture. The stability is in the term transportation. The flexibility is in the solution of transportation problems. One can then ask, "What have been the universal technological endeavors?" Combining the data shown in the slides we find only three major areas of technological endeavor, namely, production, communication and transportation.

These are some of our areas of concern. These are some of the things we have dealt with in terms of a discipline. People ask, "What is the difference between science and technology?" One description of this was by J. Herbert Holloman, former Assistant Commissioner of the Department of Commerce. He cites these myths concerning science and technology. He believes people don't really understand what science is and they don't really understand what technology is. They don't understand the relationships of technology in a culture and they don't understand what science and its relationship is to the culture. For instance, many people maintain, according to Holloman, that science and technology are closely related but he dispells this and indicates they are not. Many people believe that technology is directly dependent upon science. The best example of this myth I can quickly remember is that thermodynamics did not exist when Watt and others were working on the steam engine. The third myth--and many industrial arts people believe this in terms of solving design problems--is that science and technology proceed in orderly sequence through such steps as basic research, applied research, development, prototype testing, manufacturing, and finally, use. And then the support of science--and this was one of our topics at the dinner table tonight is the *sine qua non* for social and economic development. Without this there is nothing. Another myth has been concerned with labor. It is that technology eliminates work. The last myth has been a debate of values. It says technology destroys social values and therefore that it violates the Christian Judaic ethic that work is holy and next to Godliness.

As you look at this you find there *are* people who see a difference between science and technology. Professor Ellul in his book *The Technological Society*, indicates that there are two laws we must deal with in a technological civilization. They are: (1) technical progress is irreversible and (2) technical progress advances, not according to arithmetic, but according to geometric progression--the exponential curve. Now if this is true, then we have a problem. What effect does this or should it have on education? We are going to continue the technology we have. It is going to continue to develop. It will continue to change our social and cultural ways of life. Therefore, if we are concerned with this area and we desire to know more about it, if we accept it as a discipline to be studied, what questions should we be raising to find out what the discipline is? This is adopted from Parker and his analysis of history.

First of all, what is the discipline of technology? You answer this by trying to find out what does it do? How does it accomplish it? What tools, systems, procedures has technology matured, and so on? Then you go to the next question--what kinds of subject matter? This is one of our concerns. We have asked each of you to tell us what is the body of content for industrial arts. Is it in the technologies? If not, what would it be? What are the laws, principles, generalizations and conclusions? What are the concepts? What questions does technology ask? Of whom or what does it ask them? What is the structure of technology? We have dealt with this. How does technology reduce to practice? How does it discover and verify knowledge, move from raw data to structures and conclusions? The last question is: How does the technologist function? What effect does his labor have on the behavior of people and on civilization and culture? It seems to me, knowing what little I do about the area, that we could take a list of questions like this and by researching the area come up with a study that had relevance. Therefore, I would indicate that we do have an area that has significance which may serve as a base for future curriculum development in industrial arts. For one thing, technology doesn't have national or geographic boundaries. It has a universal aspect to it. If you read some of the current work such as Harvey Cox's The Secular City, the universality of technology becomes apparent. He indicates that the USA and USSR are moving closer together because of technology, that the kinds of government are becoming closer together, and their decisions are based on this thing called technology. It is a discipline also because it interacts between man and his environment. It is cultural. It has cultural elements and it provides a base from which to implement the objectives of general education, as I understand them. Individuals like Phillip Phenix in his work, Realms of Meaning, cites the need to identify universals. For those concerned with general education, universal technological endeavors would be very important. Technology also qualifies, historically, as a discipline. It yields appropriate sub-areas. For the present, these sub-areas can be identified as manufacturing, construction, communication, and transportation together with the social-cultural elements. The relationship would be as follows: Man's major areas of knowledge can be considered to be in the sciences, the technologies, and the humanities. The technologies have two major elements. 'Many of the people in our field have been concerned only with the technical but there are the social-cultural elements also. The technical elements are related to energy matter, people, information and environment. The cultural and social deal with change, systems, history, men, innovations and ideas. Both categories of elements are necessary for the understanding of technology. I have limited the technologies to three, but those three, production, transportation and communication, are in every culture and are universal.

Let's see what is possible in structuring a model. Transportation provides a good example. What elements are a part of any transportation system? What elements exist in any transportation problem, regardless of the environment in which the transport vehicle must function? We know, for instance, unless they repeal the laws of physics, that it does take energy or power to move a mass. You have to expend energy. We also know if we are going to move people or products, we have to have a structure to put them in. Also, if we are going to move a given structure with a given energy source, we have to control the vehicle. We also have to suspend it in some way. Support systems are also required. We have to have operational procedures and certain safety elements. These, therefore, are elements of a transportation system. There are others. This is adopted from some of the work by Ross published in International Science and Technology.

The cultural aspects, as opposed to the technical, would be concerned with man as he relates to technology including the economics of it and the systems of social change. I am very much concerned also about students knowing their place in history, having some understanding of the relevance of technology to history. Therefore I would stress the biography of the people who have worked in developing technology, the men and their ideas, innovation and invention, historical development and contemporary problems. These elements can be related to land, marine, air and space--the three environments with which transportation deals. The three axis relationship can be shown. You can take a problem in structures and relate this to the individual who made a contribution to a technical innovation in structural design in marine transportation. This interrelates the three phases--the men, the structure, and the environment.

Some work by Ross published in Science and Technology entitled: "Transportation--How to Think About It" describes various support systems and propulsion systems including propeller, friction, jet, turbine, linear induction motor, linear turbine, gravity, and others. They leave it open-ended and raise the question, "What else?" This is good because you have a structure but still it provides for new knowledge and new developments. Ross also proposes new and interesting ways to look at transportation in terms of degrees of freedom; one degree, two degrees, or three degrees. The air vehicle has three degrees of freedom; the automobile and bus, two degrees; and the track type vehicles and tube type vehicles exhibit one degree. That is one way of organizing the study of transportation.

Let's take a look at communication. One definition for communication we came up with in some work with people at the Goddard Space Center was: communication is information dissemination, storage, retrieval, and use. This is essentially what we're doing tonight--whether it's verbally, or using the graphic arts or Telstar, and telemetry. We also discover as we study communications that there are different ways information is utilized or passed on such as man to man, man to machine, machine to machine, or machine to man relationship. In addition to the utilization category we discover certain systems of communication such as: sensing, encoding, signalling, transmitting, receiving, decoding, and so on. The computer provides our model.

We have a definite problem in industrial arts when we view content from this standpoint. In graphic arts we find that we are teaching printing. Then we take a look at the programs and find we are setting type by hand. Our structure isn't set up to adapt to change. For instance, in this illustration showing the first generation of some new typesetting procedures, complete with matrix, light source, aperture, film, and the image exposed on film for further processing. This is already out of date. We have moved to the transitional stage with your "flash" lamps, movable lens, film, and stationary character grid--with characters A, B, C, D, E, F, and etc., to a second generation utilizing a moving prism, character grid, flash lamp, spinning disks, and your film, to a completely electronic system where type is not used anymore. Yet, we have been teaching skill in the printing art as it was in the Ben Franklin era and beyond. The basic concepts have changed. They are now concerned with electronics, optics, chemistry, films, and new types of composition. How do we set up a curriculum that can adapt to these new changes? Is it a mechanical solution of adding new equipment and new machinery and teaching the operations of these devices? Or, is it something else?

We have been concerned also with the interrelationships of bodies of knowledge. Some of this has been brought forth in several of the previous overlays. There are some relationships that seem important. The interdisciplinary aspects are vital if we are to understand the significance of this new technology. This might be called the study of technology and culture. Here we would be concerned with the history and development of the technologies, western culture, non-western civilization, contemporary American industry, the psychology of work, and other related topics. These I would call the social-cultural relationships as they specifically impinge upon an area of technology. We should also include men and their ideas, inventions and innovations. One of the areas of man's endeavor that has received very little attention has been his creative endeavors in technology. We have not written about these people as much as we have the people in the scientific community. Another major area of study with considerable relevance are contemporary problems of the individual, the community and government, as they adapt to technological change. There are also the inter and intra discipline relationships. Let's look at transportation. Someone in our group today said there should be some depth to which man should pursue a study. The relationships provide depth. For example, if we have a major in transportation, he will know something about energy, power, guidance, control, support, suspension and structural systems. This is his major area. What does he need to know about communication? What areas of communication technology relate? Photography certainly relates as do radio navigation and communications electronics along with information systems and the computerized control of rail systems. If he is really an expert in the area of transportation, he should have a background in geography because transportation is directly related to environment. Transportation is directly related to weather. Aviation is greatly concerned with this as well as meteorology and inertial guidance which is related to astronomy. These are relationships with other disciplines which gives us the inter and intra relationships of the disciplines.

If this approach is valid, we can, in industrial arts, derive a content structure, our objectives, methods, procedures, questions, and even our problems from identifiable bodies of knowledge in the technologies. In the past, as shown by Dr. Brown's analysis, we have attempted to do this from a craft or skill base. With respect to objectives this doesn't mean some of the objectives would not be concerned with national goals. We would, however, look at the objectives of the disciplines, find out what they are, and thereby teach the processes of the discipline.

One of our major problems, however, is to reduce the mass of information, to consolidate it, to synthesize it. For instance, all of the areas we discussed have certain elements in them. For instance, transportation, production, and communication all have research functions built in. Each area is developing new ideas, inventions and innovations. They all have a design function. They all need the support of production in products manufactured for them. The area of production is primarily concerned with products but the design and production of transportation vehicles and elements is also important. And all of these have like elements. Therefore it doesn't seem necessary to develop special research studies concerned with research in transportation or research in communication. The work of Cassidy and others indicates there is a unity. Cassidy believes there are universals in what a chemist does and what a librarian does. He believes there are like modes of thinking and doing in these activities. All of the areas have maintenance; they all have marketing functions and consumer functions. All of these areas have a structure--a history. They also relate. Transportation and communication relate. Developments in transportation have had to wait on developments in communication. All have men that have been involved as well as ideas, concepts, inventions and occupations.

If the structure is valid it should be possible to develop a taxonomy. Let's take a look at an early attempt. This taxonomy concerns one area of production and one of its elements. There are two major areas of technology--the cultural elements and the technical elements. These are sub-parts of the whole or elements. We have, then, technical elements as part of the structure and cultural elements as part of the structure. The three sub-elements of the technical have been identified as production, communication and transportation. The cultural elements would be concerned with history, development, cultural change, innovation, invention, economics, biography, men and like items. Let's follow through on the technical elements of the taxonomy. Production is composed of two major categories or elements--(1) *manufacturing* and (2) *construction*. So the *area* would be production; the *division* would be manufacturing, and the *category* would be *fabrication* and *processing* because there are two kinds of manufacturing. Amber and Amber in their book, *Anatomy of Automation*, provide a base for the taxonomy. *Fabrication* is manufacturing from discreet parts. Processing would be the manufacturing of film, paper or 24-hour operations of petroleum plants.

In fabrication we find some of the elements are related such as research and development, design and engineering, purchasing, sales and distribution, production, plant engineering and personnel departments. Production processing has sub-elements identified as materials testing, handling, working, packaging, inspecting and assemblying. If we take one of those elements, materials working, it can be sub-divided into tools and tooling, chip generating operations, bending operations, mold forming, fabrication treatment, electrical and chemical operations, assembly operations, and force operations. This type of taxonomy doesn't focus attention on materials, skills, or specific tools, but on what a tool does. Not what it is--not the name of it, but the behavior of it. Chip generation is the behavior of that tool. The sub-elements of tools and tooling can be identified as jigs, fixtures, molds, patterns, gauges, templates, machines, dies and punches. The sub-elements of one of these elements such as machines can be identified as wood hand tools, metal hand tools, semi-automatic machine tools, power machine tools and fully automatic machine tools. Fully automatic machines can be sub-divided into several categories such as: repeat cycle, self correcting, equation solving, limited self programming, relating cause and effect and creation and originality.

The taxonomy would be the discipline of technology. The technical area is production. The division manufacturing. The category fabrication. The department production processing. The function materials working. The operation tools and tooling. The type machines. The class fully automatic. The order repeat cycle.

The question is: "What is the content reservoir?" We can find out what the reservoir is by identifying the taxonomy. From the taxonomy it will be possible to move into the second stage, identification of basic principles and concepts. The next step is to identify those basic principles and concepts that relate closely together and can be taught as a unit, thereby creating units of instruction. The units that relate provide courses of study. The units are flexible as are the courses of study.

We have a problem of the distribution of emphasis between content and intellectual processes. Systems analysis may be able to clarify the problem we are dealing with. The essentialist is primarily concerned with content. The existentialist posture is more concerned with process. Systems analysis we believe would help us identify content and principles and also it would help us to determine the relationships with other disciplines and other teaching methodologies.

Dr. Cassidy of Yale, a friend and co-author with Dr. Haskell, has done some work in knowledge structure. What he has developed makes a lot of sense. His concern is the "sphere of knowledge and experience". Notice he doesn't describe it as the sphere of knowledge, but the sphere of knowledge *and* experience. He has four categories--the humanities, the technologies, the sciences, and the philosophies. Around the equator of the sphere he places areas of knowledge such as literary criticism, linguistics and logic, mathematics, physical sciences and biological sciences. Notice the relationships on the equator. The emphases are different in the humanities on the left. The emphasis is on the *metaphor and analogy*. But as you move around the equator, from subject to subject toward the sciences, there is a change in emphasis, to *analogy and ratio*. There is also an emphasis change as you move from pole to pole. The range is from the application of theory to practice, which is in the technologies, to synthesis, which is philosophy. All of the activities concern themselves with data gathering and synthesis. As I studied Cassidy's work I raised the question: Is there a sphere of universal technological endeavors? This diagram is the result. The area of concern is the physical technologies. We then have the practice of technology which Jarvie describes as *knowing how*. In addition we have a philosophy of technology which Skowlimowski and Jarvie describe as *knowing that*. We have already discussed this in our conference. We discussed *know how*, *know what* and *know that*. The other continuum, from left to right, concerns the social cultural elements or man and society. The continuum moves from the natural environment toward the right and the artificial environment.

At this point our emphasis is on the philosophies, on values, on synthesis, on knowing that. This is cognitive. The "reality" is subjective. Here we decide "what is to be?" It's a question of "Where do you want to go?" "What is your direction?" "How will you use this technology?" At the other end of the continuum the reality is "What is effective?" The reality is objective. This is the practice. These are the actual activities. You can deal with them in terms of behavior. You can make statements about them. This then can serve as our system in the physical technologies.

Now the one problem that faces us is how to get this programmed for the realities of instruction for 8 o'clock on Monday morning to a group of 10th graders. What do you do? Then after you have done it and it is published, and the teachers are prepared and are teaching, things change. The culture changes. Technology changes. How do you meet this thing called "change"? Sometimes you think that you shouldn't start. Because you know, if you have dealt with technology and the history of it, it will change. To meet the challenge of change we believe a center for the study of technology and human resources must be developed. Technology affects human resources, occupations, vocations, techniques. We need an organization responsible to study technology and human resources. The center would be composed of individuals similar to those in this group. The university would have a center that would continue to study as an ongoing function the problems. The center would feed out and initiate activities as problems develop. It would project ahead and design field programs that would relate to the public school and society, thereby meeting the challenge of change. This would be implementation. The center would feed information to a curriculum laboratory which would prepare the curriculum materials. There would be constant feedback as shown on the diagram. It would affect the undergraduate program. Curriculum resources would be used for the undergraduate program and the teachers would feed into the public schools. Experience from the public schools would feed back to the center. These are some of the ideas and background and how we think it might be possible to approach the problem.

DAWSON: Thank you very much, Paul. I know we have a lot of comments to make and questions to raise. I think it would be best, however, if we took a break for five minutes and then heard Mr. Haskell. Following this we can discuss both presentations at length.

HASKELL: Ladies and gentlemen, my title--"The Crew of the Space Ship Earth"--was inspired by Dr. Paul DeVore. Science was developed to make man understand the world; and technology, to help him operate his space ship in the universe. The things which the crew of this space ship have in common comprises the subject matter of the industrial arts. The industrial arts are concerned with that which all students, in all departments and all countries, have in common.

Now it seems to me that on a ship, the one thing that jointly concerns all sections of the crew is whether the ship is seaworthy, whether the captain is sane, and can run the ship without hitting an iceberg, like the Titanic; and without hitting a reef, like the great oil tanker off the British Isles early this year; and whether the food and water are properly stored, or whether they are going bad.

Our sciences and technologies, however, do not train anybody to think like the captain of our space ship, nor like the chief engineer. As a result, we can say definitely that the food and water on our planet are going bad. For, as Dael Wolfle, Executive Officer of the American Association for the Advancement of Science said, we are becoming more and more aware of the negative aspects of modern technology--aware that the lakes are going dead, the rivers are going foul, the atmosphere is being polluted, and the land covered with concrete and so forth and so on. We have a long and growing list. People are therefore becoming more and more deeply concerned about the management of this enormous system, our previous Spaceship--Earth.

Now this danger comes about by the way in which the sciences and technologies are being taught in our universities. And that is the following: Each discipline has become an autonomous, one-field specialty--with one set of data, one set of phenomena which it is studying, and a special language for describing it. Each discipline has developed without regard for mankind's understanding as a whole. And (forgive me for pointing this out but it is necessary that I do) when a group of cells develops autonomously, without regard for the organism in which it is growing, we call it malignant. For it is bound to, and does in time, destroy the organism. Each of our disciplines thus displays certain malignant properties. And this malignancy develops by employing, in an incorrect way, what James B. Conant has called The Two Modes of Thought; using it for just its own ends in the following cybernetic way. (SLIDE 1)

A theory is developed--say the geocentric or Ptolemeic theory of the solar system. (This is the deductive-theoretic mode of thought). This theory is then verified by observation--say Capernicus' observations of the solar system. (This is the inductive-empirical mode of thought). These observations react back on the theory producing, in this case, the heliocentric Capernican theory of the solar system. This new theory then gave rise to new observations with better instruments--say Kapler's and Brahe's observations. These new observations retroacted on Capernicus' theory, resulting in Kepler's still newer theory, in which the planets' orbits are elliptical. And so forth to the present relativistic or Einsteinian theory which accounts for a lot of new observations such as the perihelion of Mercury.

This goes on in every one of the sciences: A theory is developed, then certain instruments and techniques are used for testing it empirically. These react back on the theory and change it, or even replace it with a new one. Then further new instruments and techniques are developed for testing it empirically. These new observations are compared with the new theory. And so the thing progresses on two feet, on and on. But the point is, that it always progresses in a cumulative line, without regard for human understanding as a whole. It grows orthogenically, like a malignant growth of uncoordinated cells. (SLIDE 2) The physical sciences developed their own concepts, ideas, and notations; the biological sciences their own, the social sciences their own again; psychology its own, and so on.

The result is that we no longer have a community of scholars but instead, a community of one-field specialists. And this is called the multi-versity.

Clark Kerr has said that the one thing that the professors of all the multiversity's departments have in common is their gripe about the lack of parking space!

This common gripe, however, does not permit us to run the spaceship, Earth. There are, you know, 150,000 more people on the Earth every day than there were the day before. And you can imagine--since each new person needs at least one, and usually several acres of land to keep him going--with food, clothing, water, fuel and so forth--that it's physically impossible to continue as we are now going.

Malthus long ago pointed this out. He was, however, concerned with just one habitat change. Namely, the (relative) decrease of resources. (He pointed out that the population was increasing at a more rapid pace than the resources were increasing.) That is, however, only half of even the simplest ecological equation.

The simplest ecological equation--that for microorganismic ecosystems--was developed by Verhulst and Pearl and is represented by the logistic curve. They took into account not only the decrease of resources but also the increase of waste products. And as you remember, they represented by drawing the logistic curve. (SLIDE 3)

At the left you have no population; and at the right, the population ceiling, the number of individuals which can be accommodated by the habitat in question. Let K equal the population at the ceiling. Then the equation of the logistic curve is the following: The size of the population dN, at any given time dT, is equal to the biotic potential b, the reproduction capacity of that particular species, bN, times the unutilized opportunity for growth $\frac{K-N}{K}$. This is the population ceiling K minus N, divided by K. Thus you find the way in which the population can grow, and the limit to which it can reach:

$$\frac{dN}{dT} = bN \frac{K-N}{K} \quad \ldots (1)$$

For microorganisms in the test tube--or even in nature--it's fairly simple. All you have are two factors which determine the opportunity for growth; namely, decrease of resources and increase of wastes. Yet Malthus' equation was too simple (and also too optimistic) even for societies of microorganisms.

But when you get to even slightly higher organisms, you have to deal with simple minds. As they get more crowded (as these first two factors increase) a third factor begins to manifest itself: the increase of tensions, neuroses and allergies; in other words, an increase of mental resistances.

Then, as you get to man, even when you get to simply agricultural peoples (before they even become Literates, before the form of civilization talked of by Toynbee) you have the addition of arms races and wars which usually go on at an accelerating rate.

Now all these factors act as negative feedbacks on population explosion. All these factors limit the rate at which the population grows, and the total amount which the population can reach. They act as safety valves.

But when we come to our Industrial civilization, with its malignant form of the explosion of knowledge, the development of the multiversity, these limiting factors are not only suddenly and sharply reduced, but in some cases reversed. With the development of the several technologies, including those mentioned by Dr. DeVore, we Industrial peoples have found ways of intensifying all the pressures and at the same time ways of tying down Nature's safety valves. The ancient epidemics, for instance, no longer decimate the human populations every few decades. It keeps right on exploding. We have found ways of temporarily increasing the food supplies very fast, with chemical fertilizers, insecticides and other techniques. But their run-off is poisoning rivers, lakes and even, now, the oceans. The nervous tensions we manage to hold down at present. But we do it with tobacco, liquors, drugs, and entertainments of unprecedented proportions, preparing unmanageable waves of crime, rioting, arson, revolutions and deadly wars; deadly even to animals and plants! We have explosions here and there in the slums, and so forth, but for the moment we still manage. And we know about the fantastic arms races, unheard of in lower human Periods.

The tensions however are growing so great, and the safety valves have been tied down so well and long, that the possibility now exists that we could so badly disorganize our space ship's genetic information--not only that of man, but also of plants and animals--that in perhaps 2 or 3 generations after a general nuclear war, the mutations would be so frequent and intense that survival would be impossible, and the planet Earth would lose its crew entirely.

There are other problems developing on this ship; the build-up of carbon dioxide in the stratosphere is getting so great and so rapid that its hothouse effect, the raising of temperature, is possibly already beginning to manifest itself. An ice flow the size of Connecticut has been observed passing New Zealand in the direction of the equator. If the polar ice caps melt, the sea levels would rise so that all our coastal cities would be many feet under water. Our land area would shrink tremendously at the same time that our population is exploding. Stated in terms of the equation above, we are simultaneously increasing our population's rate of increase bN and lowering our habitat's population ceiling K. But you know what happens when an irresistible force hits an immovable object: an inconceivable concussion! That's a hell of a way to run the space ship. But when there is no captain, that's what happens.

Dr. DeVore mentioned an authority, Jacques Ellul, who declared that technology is irreversible. That is the kind of thing a one-field specialist is apt to say: he generalizes the correct picture of his field into an incorrect picture of the world, which he has never studied. Nothing, in fact, could be further from the truth. Time has shown, over and over throughout history, the breakdown and disintegration of high civilizations with loss not only of population and loss of technology, but loss even of literacy. During the Dark Ages the descendants of great peoples such as Greeks and Romans couldn't even read the inscriptions on their arches and temples, far less build them! Technology can retrogress, and tremendously. There is no reason whatsoever to believe that technology cannot retrogress, except the reason of having specialized too narrowly.

My effort, therefore--and that of C.U.R.E. (Council for Unified Research and Education)--first has been to unify the sciences into a single discipline; which we have now finally, I think, accomplished. And second, with the help of unified science, to cure the multiversity. To organize it into an institution that can develop captains and navigators and chief engineers for our great space ship; an institution which can help to orient and train its crew--its great crew, which we are--so that we will not, under the guise of "progress", be tying down safety valves but will, on the contrary, devise better ones than Nature did herself and invent ways of reducing pressures, ways that do not wreck the ship, as we are doing in this century.

Now the effort which we have made at scientific synthesis has followed, without our knowing it, the recommendations of the great philosophers of science, Leibniz and Francis Bacon. I only learned of Leibniz's predictions in 1958, when I discovered, to my great surprise and pleasure, that ever since 1940 I had been following the program which he had laid out.

Leibniz affirmed that one day it would be found, that people working in what they considered to be different fields, would discover that the constructs describing them in actual fact display a single structure. (We have shown, for example, that the ecosystems of men, of animals, of plants, and of atoms have the same structure.) The data displaying these common structures would then, he said, be put together in what he called the Demonstrative Encyclopedia. And from this, he affirmed, the structure which they have in common would be abstracted and stated in an abstract way; he thought it would be a geometry. Leibniz called this the Universal Characteristic. And he believed it would make possible rational discussion in all fields. "If someone were to disagree with me, I would say to him, 'Sir, let us calculate', and by taking to pen and ink, we would settle the question." Leibniz believed that by this method it would become possible to get a consensus, among the captain, the crew, the navigators and so on of our space ship; that they would develop teamwork and run this mighty space ship for the glory of God and the good of man. And this, I believe, has now become possible.

I don't have time to tell you in detail how this unification has developed over the last 27 years. I'll simply try to show you some results--where we are now--the kind of thing we hope soon to publish, that I'm about to start teaching at the New School for Social Research in February. May we have the next slide please. (SLIDE 4)

First let me show you the over-all framework of our synthesis--what you might call the jig for our assembly of sciences. Leibniz called it the Universal Characteristic; we call it the Periodic Coordinate System. Its development started in ancient Egypt as a one-quadrant coordinate system. This useful little coordinate system was lost during the dark ages of Egypt and was reinvented in ancient Greece; it was then again lost after the Roman empire (during our own Dark Ages), and was reinvented by Descarte and Laplace, independently of each other. This two-ray coordinate system, which is still the most widely used one today, does not use the Real number system (which has negative numbers) but the Natural number system, which does not.

What we now call the Cartesian Coordinate System was actually invented by Isaac Newton. He used the Real number system, which has both positive and negative numbers. To the quadrant of Descartes he therefore added the negative axes. So the Cartesian system's axes go from zero both to positive infinity and to negative infinity. And at any point, their coordinates (their numbers) can be reduced to infinitesmality. (SLIDE 5)

This coordinate system is extremely useful. I don't need to tell you how useful it is. Everyone here who is either a scientist or a technologist has used it most of his life. But use of the Real number system made it impossible for the Cartesian coordinate system to bring together a coherent picture of the universe, or of the space ship Earth. And this has placed it in great danger.

When we make the following changes, however, a coherent picture becomes scientifically possible; we revert to the ancient Natural number system, used by the Egyptians and the Greeks before the Arabs introduced the Real number system to the west. (SLIDE 6) We do this because any phenomenon greater than a particle--say an atom--can be reduced to zero--that is, to no atom--but not changed into a "negative atom." A dog can be reduced to no dog (which means, to lower systems--molecules, atoms, and energy), but not to a negative dog. The new coordinate system's center or origin is the point of maximum entropy or disorganization, the lower limit of organization, and is called Alpha A. The two axes of increasing organization therefore begin at Alpha, while the two axes of decreasing organization end at Alpha. They point inward. The new coordinate system's upper limit, the point of maximum organization, is called Omega Ω, and lies in the first quadrant. You can see that in Nature, Natural zero--NO at the center of our coordinate system is the limit to which any system can break down. For any given kind of system build-up and break-down occur from what we call its scalar zero circle. These concentric circles are the loci relative to which increases and decreases of any of these natural phenomena are represented. It immediately becomes obvious that this circle represents zero X, and zero Y, anything beyond it will fall outside the scalar zero circle, whereas anything below that will fall inside it. The radius vector thus describes a cardioid; the co-action cardioid.

This coordinate system is a generalization. To put it technically, it's a generalization of a simultaneous differential equation, invented by G. F. Gause, to represent the relationships of two coacting eco-systems; described by two equations of the form of equation 1. He takes, let's say, a paramecium caudatum and puts it in one cc of medium, and a paramecium bursaria in another test tube of the same amount. Then he lets these organisms multiply. Each uses up a certain quantity of medium and produces specific kinds and amounts of waste products, till it reaches its saturation point and stops. (In each case this is the top on the logistic curve, the point K.) This establishes the point of reference: the no-game (0,0) coaction, relative to which all other coactions between these ecosystems can be measured. Gause then set up two fresh ecosystems, with the same starting populations, and poured them into a single test tube, starting the "game." He found that certain species of microorganisms help each other. They utilize some of each other's waste products: (One man's poison is the other man's food). Where your waste products are food, you're helping the other organism. There are cases throughout nature in which you thus have mutual aid. Their representations fall outside the scalar-zero circle. The opposite cases, where you have mutual harm, fall inside. Predation falls in quadrant II; parasitism in quadrant IV.

The thing that started me off on this work of science assembly was the discovery that the periodic table of chemical elements falls roughly into the Cartesian coordinate system; that it can almost be mapped into it. Thus a relation appeared between that man-made geometric construct and that natural system--namely, the system of chemical elements. So I began to look to see if there were periodicity, and stratification in other natural systems as well as that of atoms. In the atoms, the electron shells are stratified, and within the nucleus there is a similar stratification. And the curious thing is, that there are just 9 empirical groups, and only 9 theoretically possible relationships; those on the quadrants, those on the axis, and the zero-zero relationship at the origin. If a system is to grow, it has to repeat these relationships over and over. In other words it has to be periodic. That is what Mendeleyer discovered when he made his periodic table. This construct was then reinforced and developed further by Rutherford and Bohr and their followers since then.

I was very fortunate. One of my professors at the University of Chicago, Clyde Allee, gave me an assignment. A man named T. H. Langlois, head of the Department of Fish Management of the state of Ohio, had sort of a problem. The State was spending thousands of dollars on fish hatcheries, but was getting very few fish. And the fishermen were mad. Elections kept coming on and pressure kept growing. The politicians wanted to find out what was the matter. Why couldn't they get a reasonable number of fish with all the money being spent? They had worked on it for years and had many people help them.

Finally some ignorant farmer had said, "Boss, the big fish is eatin' the little fish--that's the trouble!" Well they began to study it and they found, by Jove, it was true! In each of these schools of fish there was a small group of big fishes and then there was a great mass of middle sized and small fishes. The relationships between these two groups, which I shall call the Minority and the Majority, determined the major properties of the whole school: If they were helping each other, the productivity, in pounds of fish per season, was very high; the fishes remained together; they seemed relaxed, and there was low incidence of sickness. On the other hand, if the large began to eat the small, suddenly all the properties of the society changed: The productivity dropped enormously; the small fish were constantly fleeing the large, instead of eating the food that was provided; the large were eating the small, instead of eating the food that was provided; the few large fishes were growing fast but the vast number of small were not, and there was a lot of sickness. (There was apparently so much tension in this kind of fish pond that a good deal of sickness developed.) Finally, in some ponds both these groups came to destroy each other: The small were using bacterial warfare: there was a parasite, Ichthyophthyrius, in some of these ponds, living in the vegetation. The small fish, trying to flee the large in the narrow and shallow places, could remain uninfected because they were small; but the big fishes would scrape themselves on this vegetation and get infected. So, low and behold, there were ponds where the small killed off all the large! They didn't know how they did it, but they sure did it. So you were getting cases of the minus-minus coaction.

Then Langlois found, in the ponds where only the large fishes were left, the whole cycle would occur again. So also in the ponds where only small fishes were left. In other words, you had periodicity.

Thus Langlois discovered four groups--four different kinds of coaction. My problem therefore was to find how many there could be theoretically. While theoretically it was very simple to figure that out. The curious thing is it worked out the same as the chemical elements. That is, 9: All the large could do to the small was to increase their nutrition, to leave it unaltered, or to decrease it. All the small could do to the large was increase their nutrition, leave it alone, or decrease it. You cross tabulate plus, zero and minus, and you get 9 possible relationships; and they fall on the quadrants, the axes, and the origin of the coordinate system. Well as soon as I saw that, I immediately thought, is it possible that Langlois has discovered the Periodic Law, in societies formed by fish? So I corresponded with him on it. And the more I studied it, the more it seemed true. These four coactions had long been known to ecologists: Symbiosis, mutual help between the weak and the strong; mutual harm between the weak and the strong; predation where the weak are damaged and the strong benefit; parasitism, where the weak are benefitted and the strong are damaged. And then there was one other--commensalism. Commensalism was generally considered the case where the weak are benefitted but the strong are not affected. For example, a tiny vine growing on a large tree. So that falls on the X axis.

But three coactions appear in the coordinate system that have no counterpart in the literature. So we looked around and found that all of them occur in plants, animals, and men. And, of course, the no-game zero-zero coaction, where neither coactor affects the other--there are plenty of cases of that. So there really are 9 coactions.

So then I began working very hard to see whether there weren't further analogies to the chemical situation. And the more I worked, the more I realized that it's simply not possible to discuss the development of plants or animals or men in isolation from their habitats. In isolation they simply are not developing systems; they don't evolve; nothing happens. Plants live only in their habitats. And I have defined habitat as all things affected by an organism or which affect that organism. It's only the organism habitat system that evolves. The tiny algae--they live on bare rock. After they have died for a while, a few million years, they produce a little soil; a little nutritive crust. The algae have prepared the habitat for mosses, which are mutated algae. Then the mosses make more and better soil which can support leaf plants, mutated ferns. It's always the organism-habitat system, the ecosystem, that evolves. We just couldn't limit ourselves to a taxonomy in terms simply of the organisms. (This had been done by Linnaeus and the biologists; it is called the phylogenetic series and is most useful. We don't say it is not useful; we use it all the time.) We, however, had to develop systems concepts. And when I had developed those--periodicity, stratification, and the 9 groups, appeared over and over in plant, animal and human ecosystems.

I can, however, only show you 2 or 3 examples. May we have the next slide please. (SLIDE 7)

This is the kingdom of atoms--it's taken from a textbook. This simply gives an idea of the way in which stratification occurs. In the first period--as you remember, hydrogen and helium have only one electron shell, only one stratum. Then, in the second period, you get two strata; in the third period 3, in the fourth 4. It's not entirely without exception. It's not completely regular because of the so-called rare earths, elements in which the electrons are added to inner rather than outer electron shells. But this diagram gives you an idea of the way in which the number of the period and the number of its strata generally correspond. May we have the next slide. (SLIDE 8)

We come now to the plants. You see again how period 1 has 1 stratum, period 2 has 2 strata; period 3, 3 strata; and period 4, 4 strata. Next slide. Here you see it again: the number of strata determines the period's number. That's all we have time to say here. (SLIDE 9)

We come now to the Human Periodic Table. (SLIDE 10) You remember, perhaps, the Yankee City Series, by Lloyd Warner and his Associates. (He was one of the members of my Interdivisional Committee at Chicago--6 volumes written about Newbury Port, Massachusetts.) This city belongs to Industrial civilization. And that is human period 6. Lloyd Warner found the following six social strata: lower-lower, upper-lower, lower-middle, upper-middle, lower-upper and upper-upper. The top 3 together comprise about 12%; the upper-upper, 1½% of the population; the lower-upper also 1½; the upper-middle a little under 10%. The biggest class is the lower-middle, the second biggest is the upper-lower, and the third biggest is the lower-lower class.

Now let's take the opposite extreme: Human Period 1, the Lower Hunters. These are the hordes of people such as the pigmies in the Congo or the Arunta in the deserts of Australia. They live in hordes of 10-20-30 people, and they have only one social stratum. They are simply ruled by the grandfathers and grandmothers--

the council of old men and women. Human Period 2, the Higher Hunters, and Lower Agriculturalists, have 2 strata. They have several villages--governed by the tribal council, and each village has its own council of old men. And they are nomadic. These are not villages in the sense of having any stable houses; they plant a few things, and they hunt. When depletion of the habitat has occurred, and waste products are piled up, they move somewhere else. That's the way they overcome this limitation to their life.

Let's skip now to Period 5--the Literates--the people who have developed literacy. These are the great civilizations such as Toynbee has described. They are the 5th Period and they have 5 strata. Slaves and cerfs, phlebians, knights and the lower priests, the patricians and the higher priests, and then the high priests, emperors and consuls--5 strata. Finally, when we get to the sixth Period--the Lower Industrialists, ourselves--you have, as we saw, 6 social strata.

Now I know very well that there is a great deal of controversy about the exact number of social strata in our society. Sociologists have found that some small towns in the Middle West have fewer strata than 6. But that's as you should expect: a small town may have just the three lower strata and none of the upper ones.

In fact, as our ancestors came west, we always had a sequence. First came the men of broken fortune--fleeing from the police; or debtors, fleeing from creditors, and so forth. They would break a little sod, ring some trees and kill them, plant some corn and beans between the stumps. The fire was in the middle of the house; there were no windows and the smoke found its way out through the rafters. They were the first stratum, what Warner called the lower-lower class. After a while came better farmers who cleared the stumps and so on. There is a very good study made of it--by Benjamin Rush, a contemporary. But what I'm trying to say is simply that our theory requires precisely that you do not find the whole range of six strata in each of our villages, towns and cities.

Well, what I'm trying to say is, that as a result of all this it should be possible now to teach this whole range of sciences as a single discipline. The crew of our space ship can thus get a much clearer, more coherent picture of this vast space craft, of which we are the main controllers. We now can have a far better idea of the secondary, tertiary, quadanary effects of our own technological processes.

What we have now is scattered efforts which are not coordinated and which, individually, are of small consequence. Here are three:

As you probably know, there are very easy and good ways of slowing the population explosion. Cornell University and two others demonstrated this in Formosa. All they had to do was to ask the women: How many children do you need? The women had thought they needed 6 or 7--but this was culture lag--they had needed 6 or 7 before the introduction of modern medicine. In the past, 3 would die, or 4 would die, and of the 2 who grew up, 1 one would perhaps be incapacitated in some way, and just the other would take care of the old father and mother. But when the social workers asked them, the women suddenly began to think--today we don't need that many, because everybody's children are growing up now and very few die! The result was that the test region's birth rate dropped very sharply, for the social workers who asked the women this question also gave them means of contraception. However, in the control area, where these questions were not asked, the women didn't use the means, which were equally available, and the population continued to grow just as fast as before.

Now take the case of Cotrell precipitators. It was discovered that some big manufacturers who had been devastating the countryside with poisonous fumes, by being forced to put Cotrell precipitators in their stacks, suddenly found themselves making more money! They were precipitating valuable chemicals which they could sell! Or take the State of Ohio. A law was passed there, forbidding people to strip-mine and leave the land in a state of chaos. The mining companies were thus forced to smooth the strip mines down. And they found, to their amazement, that though they had expected nothing to grow there, very good crops indeed grow there, and that these are very valuable agricultural assets.

So you see that it is possible, if we think coherently, and if we see and act in a statesmanlike fashion--as befits the captains, the navigators or chief engineers--there are ways of making this a space ship space-worthy.

And I hope very much that the course I am going to teach at the New School for Social Research this coming spring may be sort of a simulation of what can happen at the University. My proposal is--and I was delighted to hear Dr. Drake say that something similar to this is already being carried out at the University of Michigan--that by using this new book of mine, "Assembly of the Sciences," a university president can convene members of his academic departments who are interested in synthesis, and create a University Seminar. With a consultant who is a specialist in synthesis to assist the process, a few months of discussion might develop, wherein the representative of each discipline examines carefully whether and how he can use the notation of this assembly of the sciences in teaching his discipline; thinking in its terms, and calculating in terms of the Periodic coordinate system.

If, then, a consensus arises in the faculty, these people will begin writing textbooks for their several departments; writing them in such a way that their students, right from the beginning, think in terms of these categories, reverse the centrifugal development of the multiversity into a centripetal development which would create the new university. (SLIDE 11) This is the school for future captains, engineers, and the successful crew of the space ship plant Earth. For in this new university the advance of any discipline--physical, biological, psycho-social--is much more easily understood by the people in all the other departments, and can be far more useful to them than they are at present.

I have found, over and over during my 27 years of working in the field of scientific synthesis, that where in one discipline phenomena were obscure for one reason or another, analogous phenomena in another field could often be, for some reason, well understood. Clues from that discipline therefore often illuminated obscurities in the first. There was mutual help and mutual advancement, as a result of this geometric language, common to all scientific disciplines.

It seems to me, however, that not only the scientists, but in due course the technologists, the industrial arts people, should be able to link up the system-hierarchy of concepts with each other all the way.

You know how biologists have linked up now with physical scientists through molecular biology. There now is almost a continuum from physics through genetics to the cell structure. I am firmly convinced that this continuum can be extended upward through all the psychosocial sciences, and that these, jointly, will become a single discipline; a coherent scientific understanding capable of helping us to engineer and navigate our Spaceship, the planet Earth, successfully. Thank you.

Legends for Figures: E.F.Haskell *

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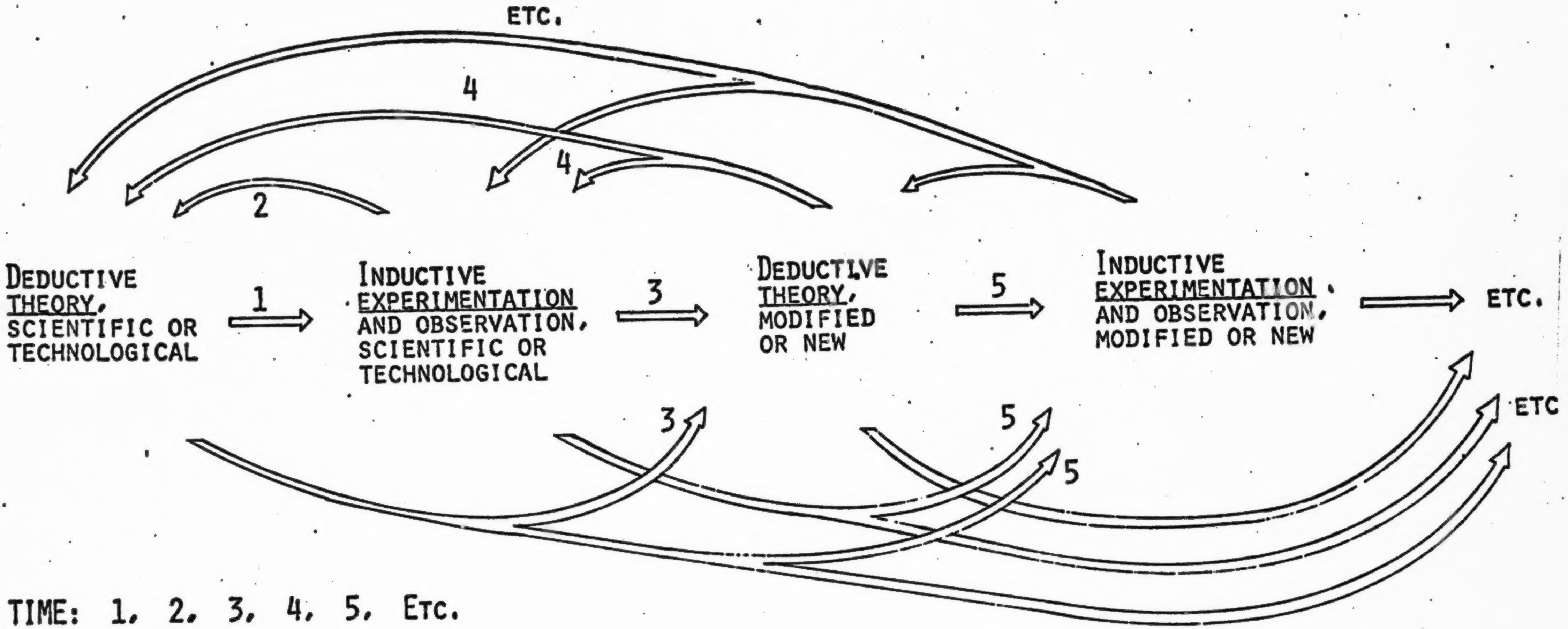
** From G.F.Gause, "The Struggle for Existence,", page 35, by courtesy of the Hafner Publishing Company, New York, London.

SLIDE 1



DEDUCTIVE THEORY, SCIENTIFIC OR TECHNOLOGICAL

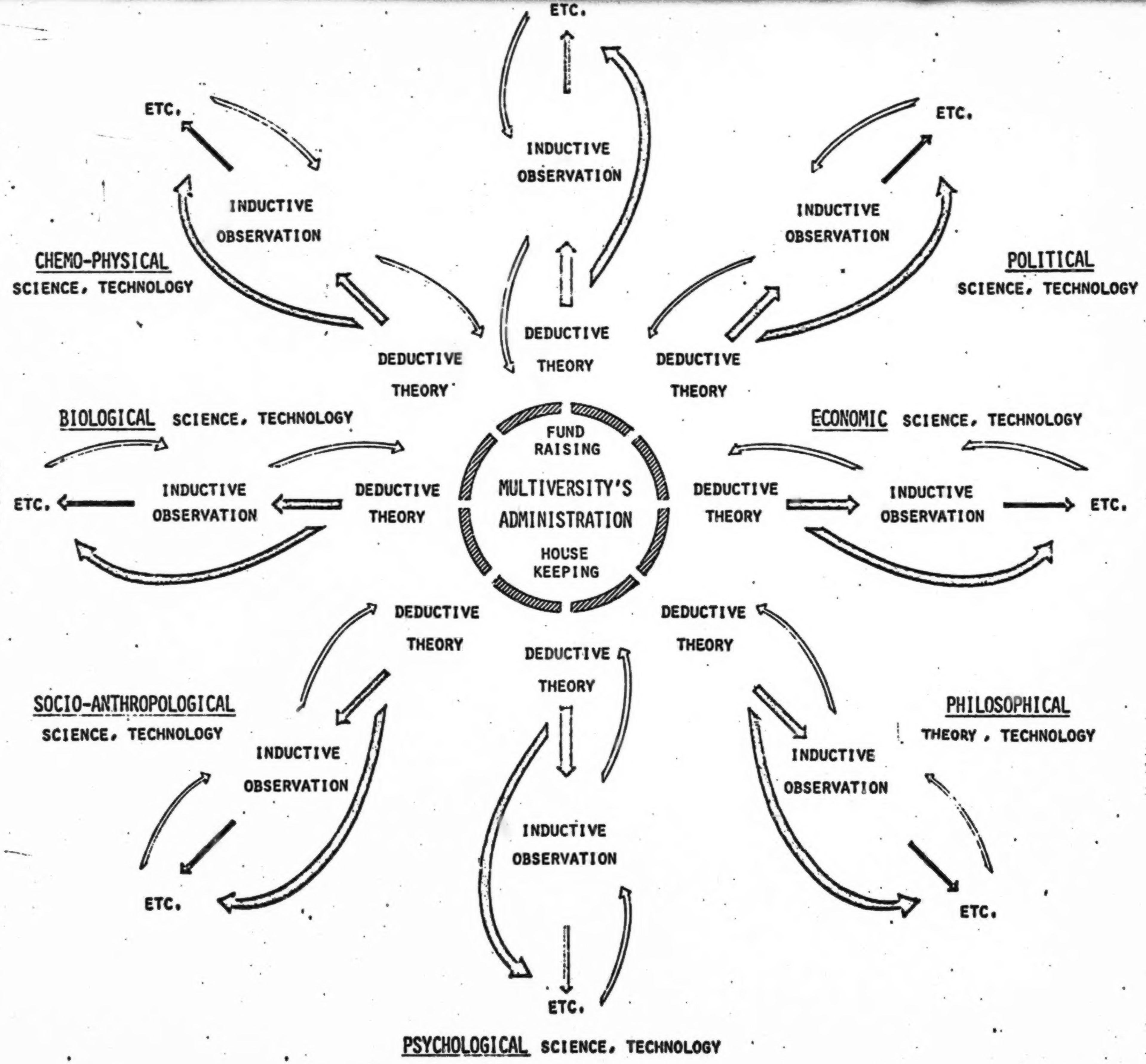
INDUCTIVE EXPERIMENTATION AND OBSERVATION, SCIENTIFIC OR TECHNOLOGICAL

DEDUCTIVE THEORY, MODIFIED OR NEW

INDUCTIVE EXPERIMENTATION AND OBSERVATION, MODIFIED OR NEW

TIME: 1, 2, 3, 4, 5, ETC.

163/



FUND RAISING

MULTIVERSITY'S ADMINISTRATION

HOUSE KEEPING

DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.

DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.
POLITICAL SCIENCE, TECHNOLOGY

DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.
ECONOMIC SCIENCE, TECHNOLOGY

DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.
PHILOSOPHICAL THEORY, TECHNOLOGY

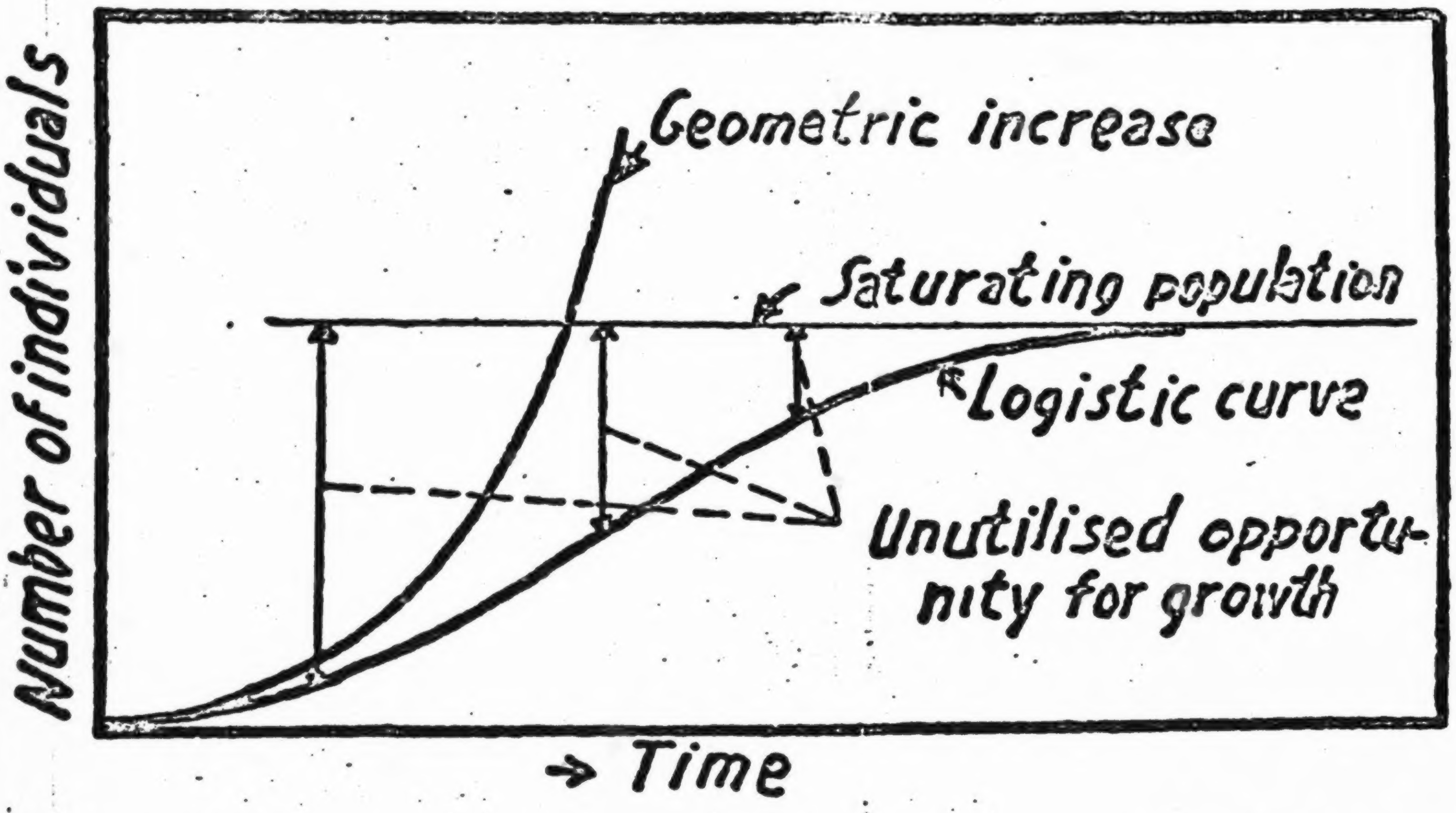
DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.
PSYCHOLOGICAL SCIENCE, TECHNOLOGY

DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.
SOCIO-ANTHROPOLOGICAL SCIENCE, TECHNOLOGY

DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.
BIOLOGICAL SCIENCE, TECHNOLOGY

DEDUCTIVE THEORY
INDUCTIVE OBSERVATION
ETC.
CHEMO-PHYSICAL SCIENCE, TECHNOLOGY

SLIDE 2 -



Slide 3, p256

SLIDE 3

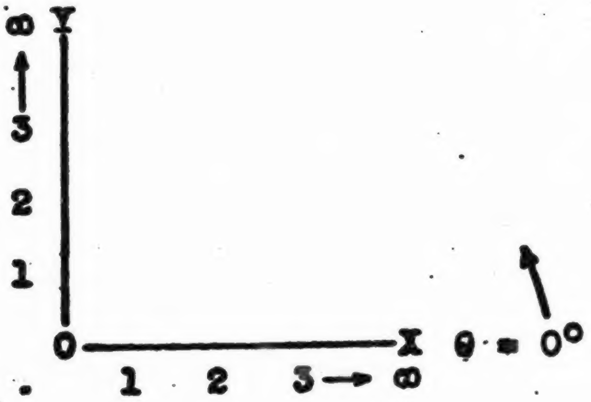

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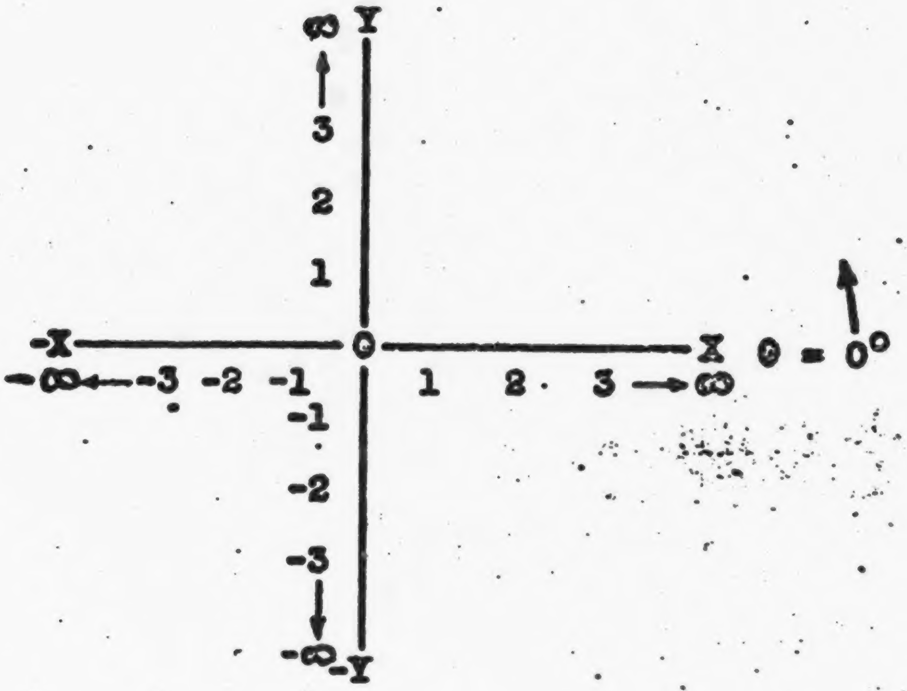
Figure ~~2~~ 4

SLIDE 4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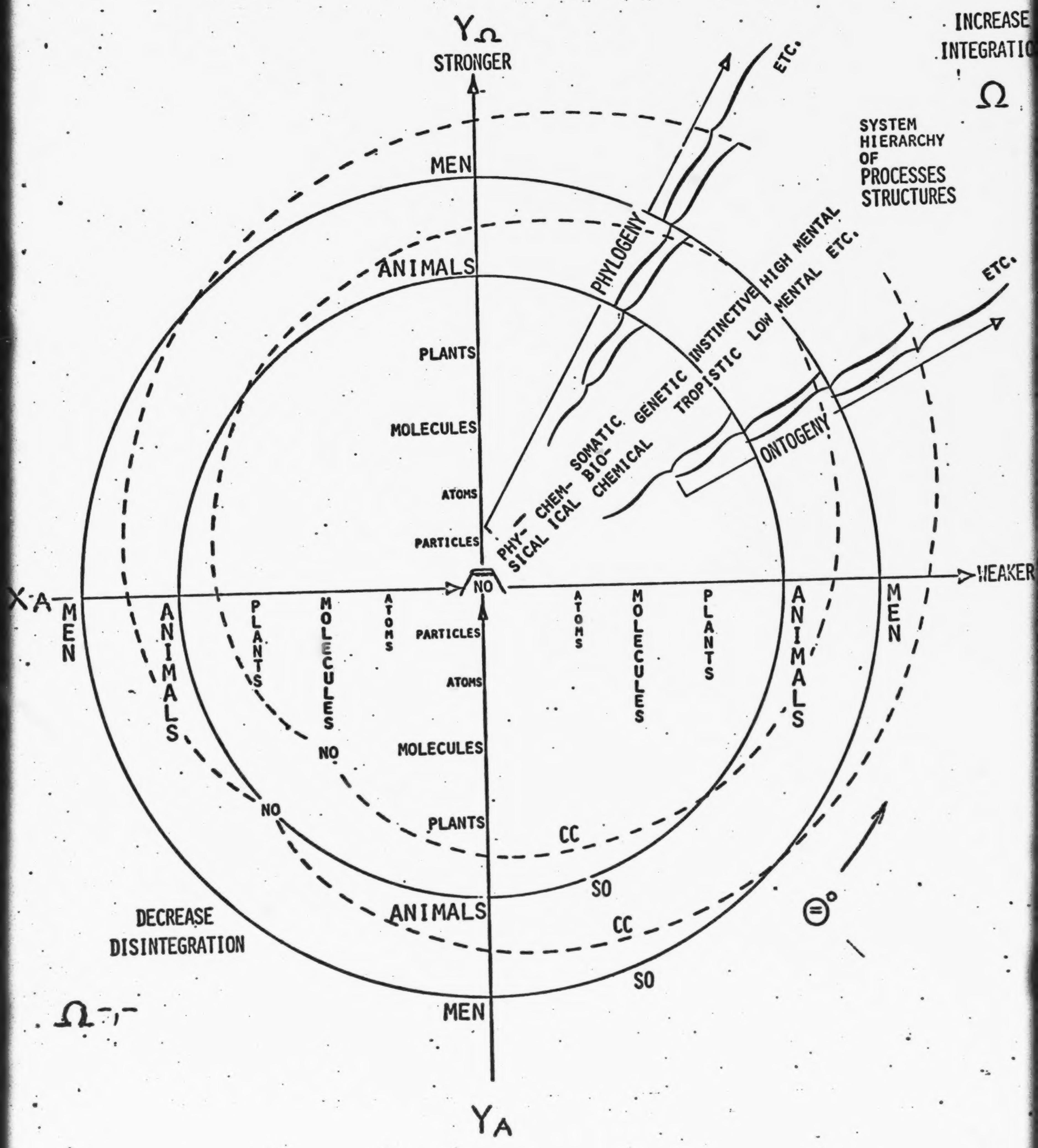
-Y

Figure ~~4~~ 5

SLIDE 5


YΩ
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OF
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STRUCTURES
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ETC.
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MOLECULES
ATOMS
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INSTINCTIVE LOW MENTAL
HIGH MENTAL ETC.
ONTOGENY
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WEAKER
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ANIMALS
PLANTS
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ATOMS
PARTICLES
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DISINTEGRATION
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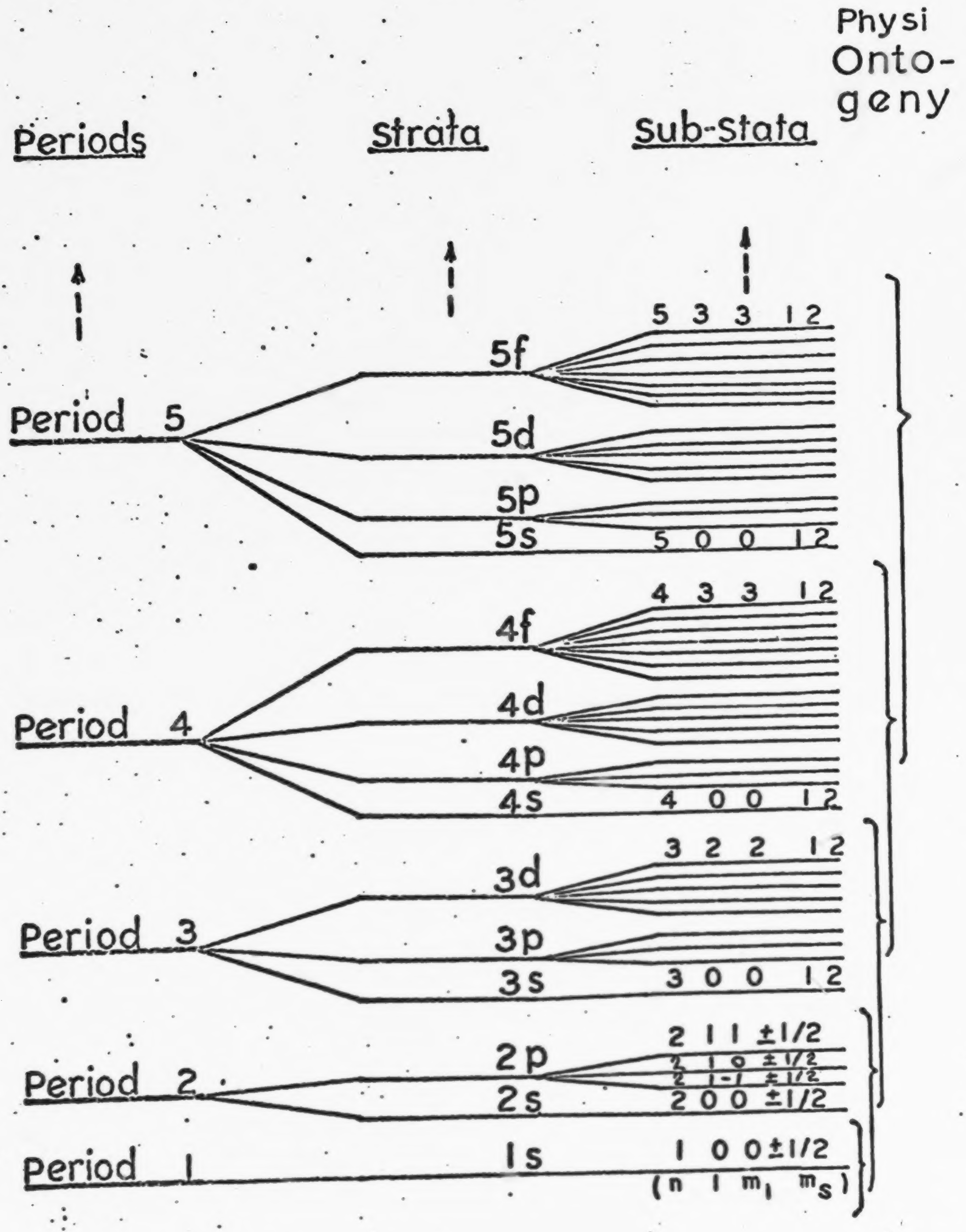
YA

SLIDE 6

~~10~~ 6


Physi Onto-geny
Periods
Strata
Sub-Stata
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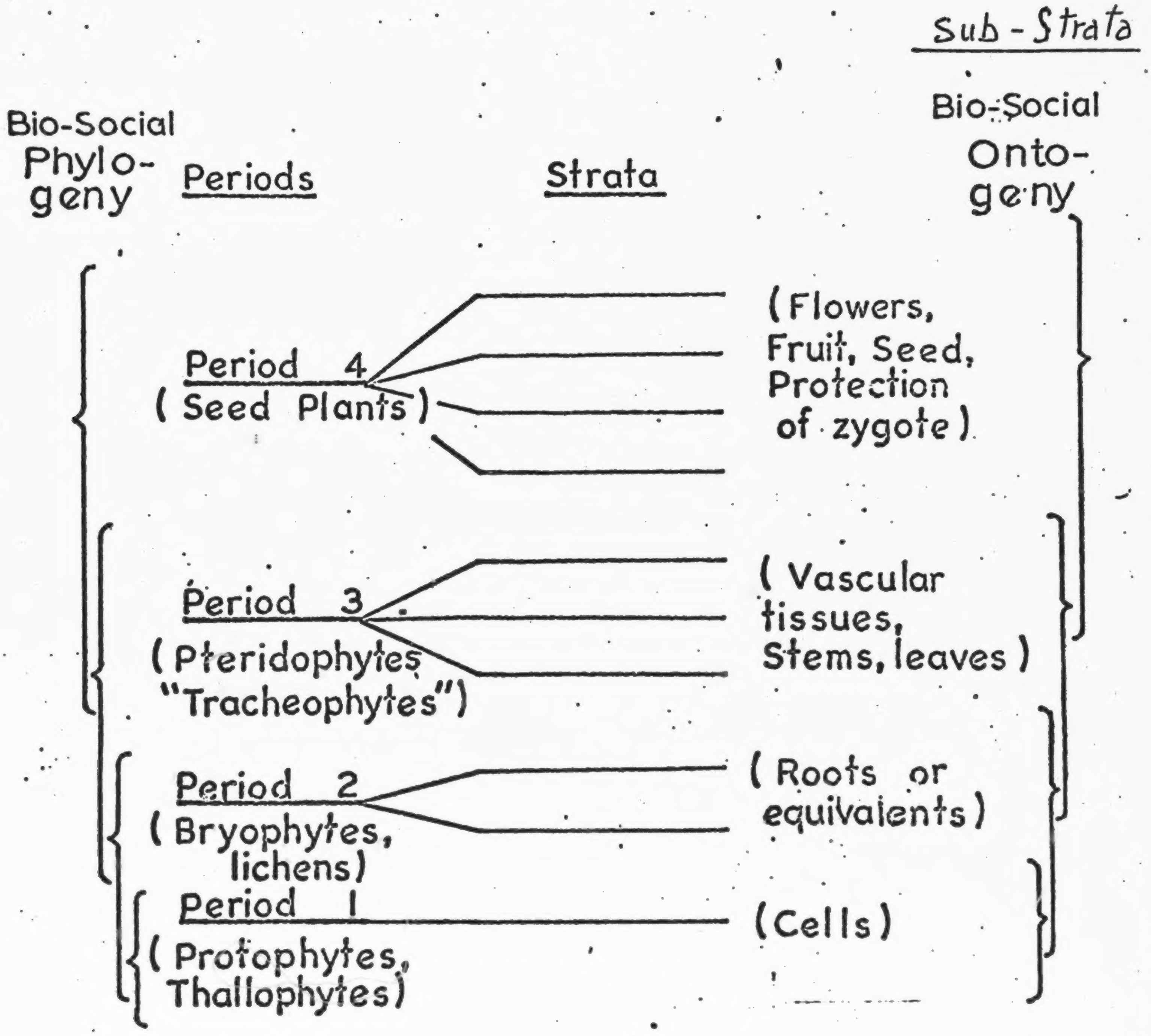
5f
Period 5
5d
5p
5s
5 0 0 12
4 3 3 12
4f
Period 4
4d
4p
4s
4 0 0 12
3 2 2 12
3d
Period 3
3p
3s
3 0 0 12
2 1 1 ±1/2
2 1 0 ±1/2
2 1 -1 ±1/2
2p
Period 2
2s
2 0 0 ±1/2
Period 1
1s
1 0 0 ±1/2
(n l m$_l$ m$_s$)

KINGDOM of ATOMS

Figure 87

SLIDE. 7



Sub-Strata

Bio-Social Phylogeny

Periods

Strata

Bio-Social Ontogeny

Period 4
(Seed Plants)

(Flowers, Fruit, Seed, Protection of zygote)

Period 3
(Pteridophytes "Tracheophytes")

(Vascular tissues, Stems, leaves)

Period 2
(Bryophytes, lichens)

(Roots or equivalents)

Period 1
(Protophytes, Thallophytes)

(Cells)

PLANT KINGDOM

SLIDE 8

Figure 8

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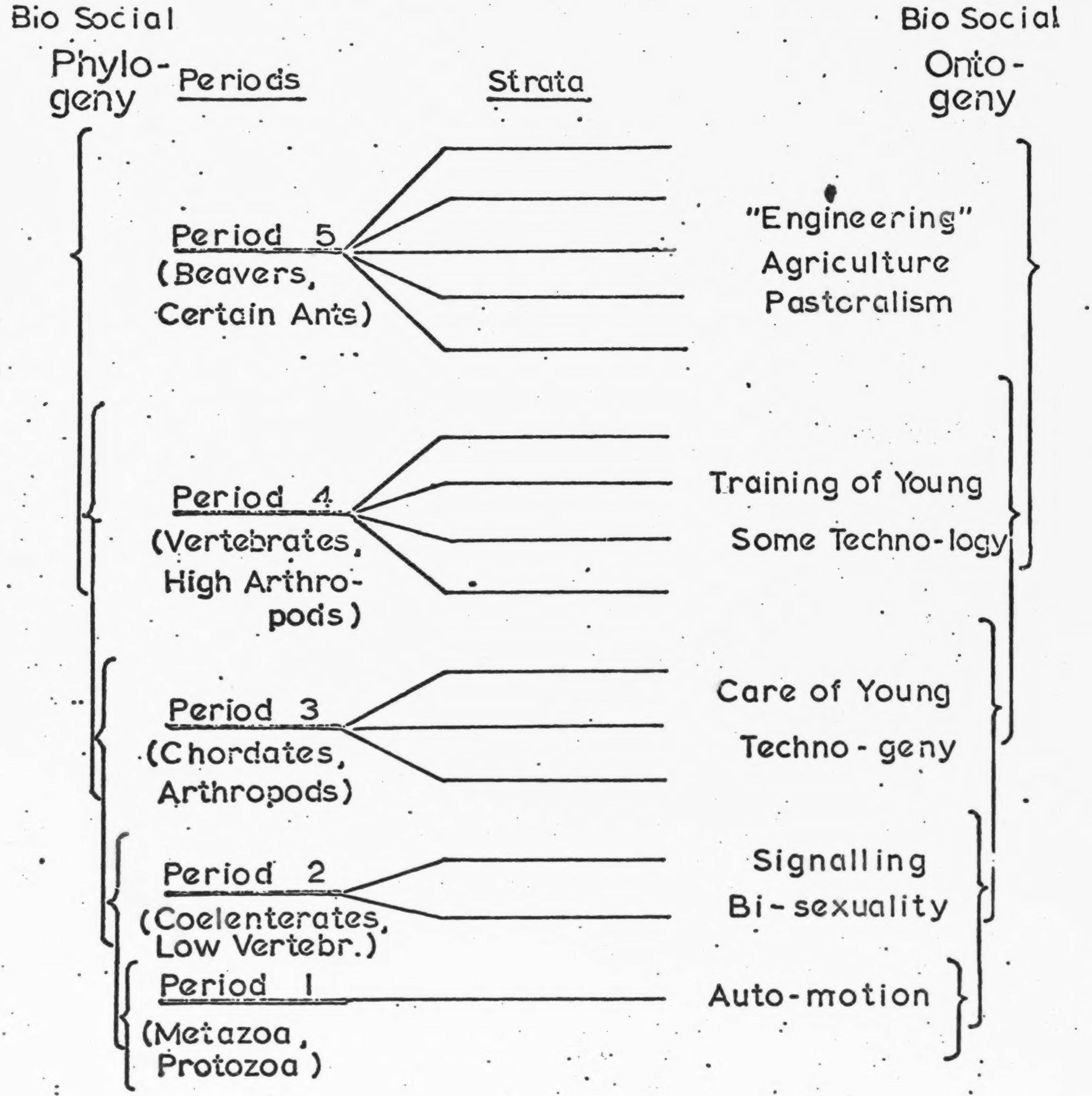
Sub-Strata



Bio Social Phylogeny

Periods

Strata

Bio Social Ontogeny

Period 5 (Beavers, Certain Ants)

"Engineering"
Agriculture
Pastoralism

Period 4 (Vertebrates, High Arthropods)

Training of Young
Some Techno-logy

Period 3 (Chordates, Arthropods)

Care of Young
Techno-geny

Period 2 (Coelenterates, Low Vertebr.)

Signalling
Bi-sexuality

Period 1 (Metazoa, Protozoa)

Auto-motion

ANIMAL KINGDOM

Figure #9

SLIDE 9

3

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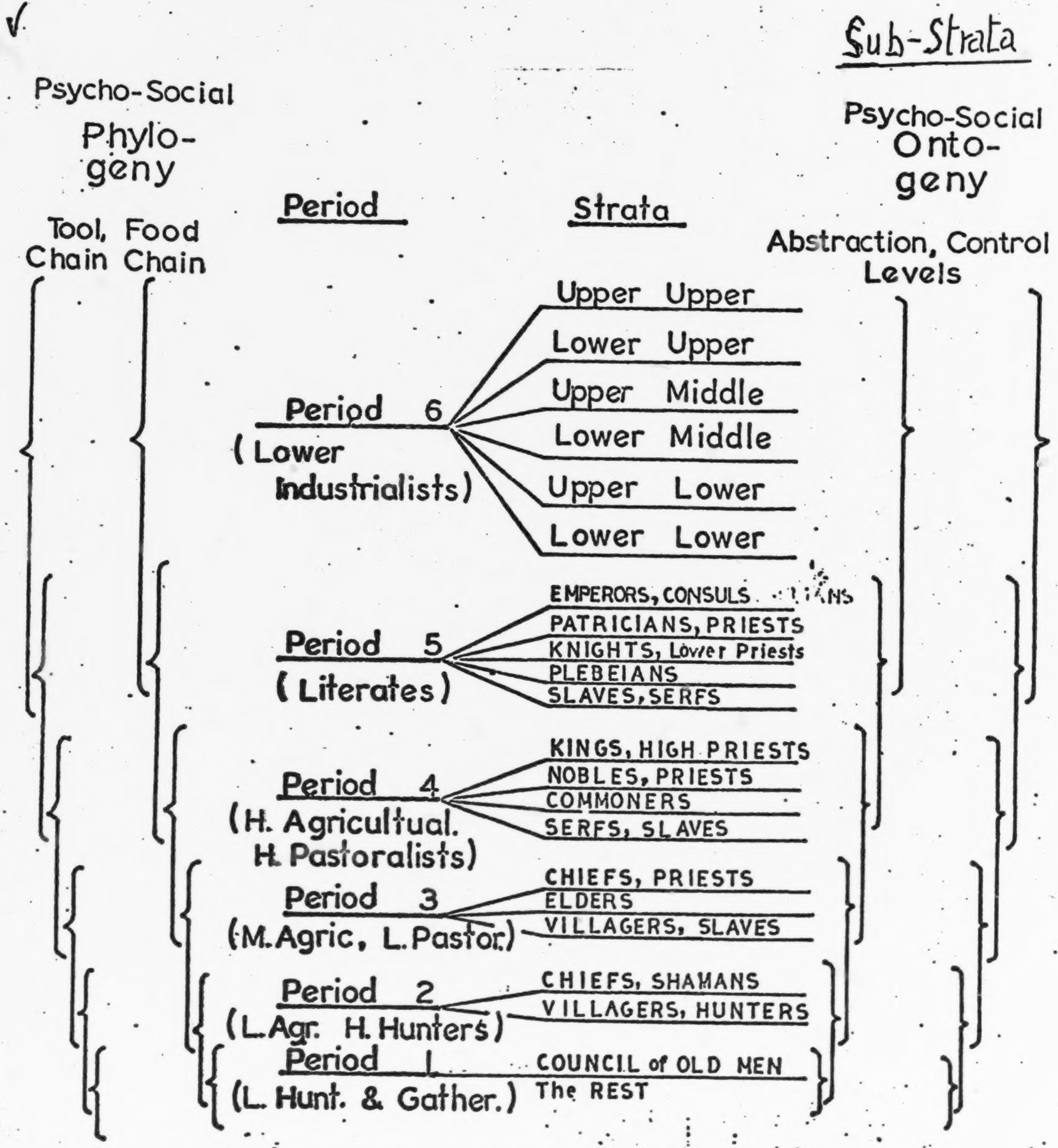

Sub-Strata

Psycho-Social Phylogeny

Tool, Food
Chain Chain

Period

Strata

Psycho-Social Ontogeny

Abstraction, Control Levels

Period 6 (Lower Industrialists)
- Upper Upper
- Lower Upper
- Upper Middle
- Lower Middle
- Upper Lower
- Lower Lower

Period 5 (Literates)
- EMPERORS, CONSULS [illegible]NS
- PATRICIANS, PRIESTS
- KNIGHTS, Lower Priests
- PLEBEIANS
- SLAVES, SERFS

Period 4 (H. Agricultual. H. Pastoralists)
- KINGS, HIGH PRIESTS
- NOBLES, PRIESTS
- COMMONERS
- SERFS, SLAVES

Period 3 (M. Agric, L. Pastor.)
- CHIEFS, PRIESTS
- ELDERS
- VILLAGERS, SLAVES

Period 2 (L. Agr. H. Hunters)
- CHIEFS, SHAMANS
- VILLAGERS, HUNTERS

Period 1 (L. Hunt. & Gather.)
- COUNCIL of OLD MEN
- The REST

KINGDOM of MAN

(But see Fig. 13)

Figure # 10

SLIDE 10

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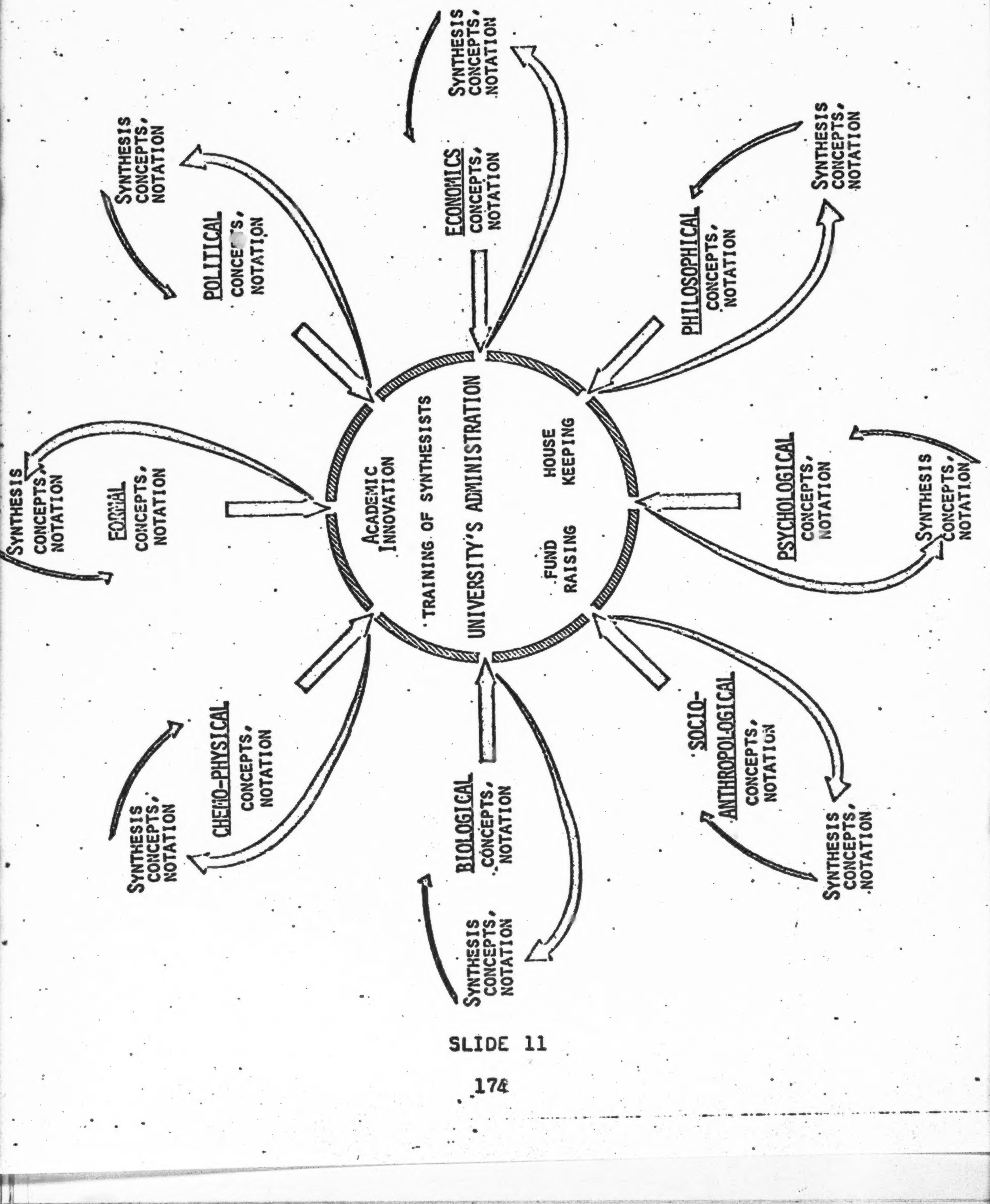

ACADEMIC INNOVATION

TRAINING OF SYNTHESISTS

UNIVERSITY'S ADMINISTRATION

FUND RAISING

HOUSE KEEPING

FORMAL
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

POLITICAL
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

ECONOMICS
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

PHILOSOPHICAL
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

PSYCHOLOGICAL
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

SOCIO-ANTHROPOLOGICAL
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

BIOLOGICAL
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

CHEMO-PHYSICAL
CONCEPTS, NOTATION

SYNTHESIS CONCEPTS, NOTATION

SLIDE 11

DAWSON: Thank you very much, Mr. Haskell. We're on the way--we've taken off--I wonder where we'll land. The floor is open for brief comments concerning either Dr. DeVore's or Mr. Haskell's presentations. Let's spend the rest of the evening, as long as you like, with these two gentlemen. Do you have any questions or comments?

I was interested in the social breakdown here. I believe you have 6 breakdowns, Ed, in the upper echelon. Bernard, amazingly enough in his "Human Development in Western Culture," identifies only 5--he says there is only one upper group, whereas others will identify 9 levels with a middle group in each classification.

MULLER-THYM: I want to ask Paul what he probably wants to ask us. Your presentation was very impressive. Where will you get your faculty?

DE VORE: We have a pretty good group already. I would hope that each of you would leave some recommendations. If we are successful in getting someone to underwrite this project, it will require a number of different disciplines and a lot of different people within these disciplines. We're searching all the time for people. We've tried to bring a lot of different backgrounds to bear on the problem already. So we are searching for people who can make contributions and give us insights into structures and organizations. The Dean and others have charged us to develop a program that projects to the future.

SINCLAIR: Will your ongoing research group perform part of that function?

DE VORE: Yes, ultimately. We would be interested in having an historian who would like to work on some of these units, to go into teaching units, and serve as a resource person for the preparation of teachers--this type of thing. Perhaps somebody from IBM who would want to spend a year or two working on certain units in the whole field of communication, if that is an area.

DAWSON: I would think, Paul, that you would want to expand this resource to include the areas of psychology, sociology and economics.

DE VORE: That's right. I think this refers to the correspondence I have had with Mr. Haskell. It is obvious that the problem is interdisciplinary and many disciplines must come to play.

DRAKE: It seems to me, Paul, that you've given a tremendous amount of thought to the area. In fact, I felt overloaded at times. It's really an excellent job. I noticed, at least in the way I thought about it, that you have almost intentionally avoided tying down specific objectives.

BRENNAN: This has been a problem before.

DRAKE: That's one of the reasons you have gathered these people together.

DE VORE: That's a good point to bring out. It was intentional. Dr. Ikenberry and I have discussed this point earlier. The absence of objectives comes from a reaction to typical curriculum efforts. We are searching for a different answer to curriculum design. Traditionally, curriculum designers have always said, "What are our objectives?" They list them, then they go on and do something else. They have had little or no effect on curriculum.

BRENNAN: The objectives are written in vague terms of "to understand something." This could mean anything to anybody. They are not written in specific enough terms to implement them, measure them, and evaluate them.

DE VORE: I have intentionally concentrated on content. The question is: "What is the content?" "What are the activities of man?" Once the content and processes of the discipline are identified we can derive objectives as the disciplinarian in that field sees his objectives. These we strive for along with national goals and vague general objectives. The omission has been intentional and I believe successful.

DRAKE: The process of using the systems approach is often thought of as stating your goals and objectives and then determining how you go about fulfilling them. The fact of the matter is that it's an iterative process. It turns out that the means are not independent of the objectives in that the analysis of the problem reflects and sheds new light on the objectives. I wonder if we're almost to the point now where we should try to toss up a straw man, or attempt to state explicitly what the objectives are.

MULLER-THYM: I think there are a couple I can suggest. You see, we've had about 45 minutes since Paul's talk. Like all of you, I was terribly impressed and it's almost downgrading the achievement to talk about it. I do have a couple of questions of detail which wouldn't affect the methodology at all. They deal with the categories that you've set up--let's say transportation, communication and production.

My guess is that there is some kind of real, absolute discontinuity, that is technological change. As the wheel itself was an incredible technological advance, as was probably the ability to capture the energy from steam and as was our ability to go directly from the movements of electrons in a shell to the flow of electrons in a wire. It is still much more desirable than using a nuclear reactor to generate heat with a waste product, that creates steam to turn the turbine. This is utterly silly. It may burn up coal but that's all you can say for it.

I have a feeling I'm going to work with you on Transportation, Communication and Production, and if at the same time you are able to, at the admission of damaging any of your philosophical apparatus, to take the kind of development of systems, or orders of systems that Ed is suggesting, and mv guess is that you could plot them--and I'd like to have some of the group's reaction to this--to the kind of history of these advances in technology--some of them with small problem steps, others with major discontinuities. We should have a couple of things to increase understanding, that would give you the mechanism also of not becoming obsolete within the framework of your own design. That's one of the things you'd want to do. These are just initial thoughts generated by the two--juxtaposed on the presentations here tonight.

DAWSON: During Dr. Micheels' presentation he encouraged this group to make an effort to define industrial arts and we have been asked to help identify objectives for industrial arts. It would seem to me inappropriate to try to do either one at this point. I think, frankly, these people are not going to need a definition for what they're doing. I am sure that even though Paul has not built in objectives here, he has sufficient information to develop objectives whenever he wants to. It seems to me we need to encourage Paul along the lines in which he has presented tonight. I wish him Godspeed. We will continue our talks tomorrow in the identification of the content area. Is that the way we should go in your mind, Paul?

DE VORE: That is up to the group. I don't want to set any stage. I want to get--and we have been getting--the feedback.

ALLISON: I think, Paul, you have taken our words away from us because you have given such a magnificent presentation. I feel like the policy adviser. You know the old story about the centipede who didn't like his 100 legs and didn't know what to do about it. He went to the policy adviser. The policy adviser said, "Well I can understand your problem--I suggest you become a mouse." And the centipede said, "OK, how do I do that?" And the adviser said, "That's not a policy matter." I feel now that I'm stumbling around trying to find something to top your show, but I couldn't find it if I tried.

DAWSON: Why don't we call a moratorium on the study which was called by a moratorium for the evening? We'll be back in the morning. Bernie--you want to comment before we adjourn?

MULLER-THYM: Just a footnote on your presentation, Ed. There are some examples in psychology, I think, where the number 9 seems to turn up when attempting to categorize this information theory. 9 plus or minus 2. It used to be 7, now some of the teachers and the editors are arguing that it's 9, plus or minus 2.

HASKELL: What's the reference on that?

MULLER-THYM: Coombs has it in his book. In the area of mathematical psychology, Clyde Coombs in his book, "Theory of Data", attempts to classify types of data and comes up with the quadrant system which essentially classifies it into 8 sets, plus the null set--or 9 sets.

DAWSON: I think this has been tremendous this evening. Remember we are due here at 8:30 in the morning. We will have the 2 divisions again for discussion so each chairman will be responsible for organizing for 8:30. When we should have the 2-minute reports, I am not sure. I think we should not have them probably until we come together after both presentations. At 10:45 we will have a general discussion and recommendations from the second section reports and we'll build all that into one composite tomorrow. That's all. Thanks again--see you tomorrow!

Friday Morning
November 10, 1967
Group 1 - Discussion
Dr. William Micheels, Chairman

SINCLAIR: We raised an issue yesterday that I would like to raise again today, which may or may not be germain. That is, does industrial arts, or man and technology, have any special implications as regards the function of education in a democratic society?

MICHEELS: I don't know that I quite follow you.

SINCLAIR: Does industrial arts education have a special function in a democratic society--or a different function, as opposed to a non-democratic society?

MICHEELS: As it holds to...

SINCLAIR: As opposed to a non-democratic society.

DE VORE: Autocratic, totalitarian? I raised the issue at breakfast this morning, following Bill Drake's questions last night of "Why don't you have a definition?" "Why don't you have objectives?" As you look at industrial arts, if it is to be a part of education, general education, which implies that it has a function for all students, then it must contribute to the preparation of the type of individual who will function in a given kind of society. The direct implication is that every individual needs a certain level of competence to operate within a given society at certain levels of sophistication. As society changes, education has changed to meet societal needs. If you have a democracy this implies that individuals make choices, determine their actions and have voting power. If the democracy is an agrarian society only, this is one type of structure that would demand certain kinds of education for the society to function effectively. The citizens must be educated to certain kinds of doing, certain kinds of performance and decisions. If you have an industrial society, as Professor Haskell referred to last night in his levels of development of man, this implies a different kind of education for a different kind of man to function in a different kind of society. It is made up differently:

It has different kinds of skills required by individuals, different kinds of information, knowledge, judgment, decisions. If you are passing through the industrial society to a post industrial society into a cybernetically oriented system with a technological base, then it seems there are direct implications for education.

The question is: What knowledge, what behavior, what understandings are of most worth to this individual when he finishes his formal public education? There is only so much time in a public school program and in a student's formal education. To perform effectively as an individual, as a human being, as a member of a social group, a society requires a given education relevant to the society. So, I see direct implications and in fact it's the basis of the whole rationale of why one studies in the major knowledge areas of man. These had been cumulative and they are the base for what we have to understand.

SINCLAIR: Edward has mentioned Toynbee's work before and it's appropriate perhaps to say that Toynbee suggested 2 primary forces of modern society, industrialism and democracy. In this country, there is a particular, peculiar relationship between these 2 forces, as in no other nation in the modern world.

HASKELL: Well to me, I think our democracy has become completely unviable; our form of democracy, egalitarian. It was not what our founding fathers set up. They had no such concepts and could have well predicted our predictament now by projecting the trends. de Togueville said this concept of egalitarianism will lead to chaos. It's perfectly feasible to have a democracy of the kind that Benjamin Franklin had in Philadelphia. This was exceedingly effective because it was not an autocracy or dictatorship at all. It used, long ahead of time, the principles of cybernetics in politics and in government. Cassidy and I made a study of it entitled Plain Truth and Redirection of the Cold War.

SINCLAIR: In a state university such as West Virginia University, you know intuitively, if not specifically, the success you have in the legislature depends at least upon a nod in the direction of a democratic education.

IKENBERRY: I don't think there is essentially any basic quarrel here at all. Basically a society needs its alternatives. The difference between a democracy and a tyranny or a dictatorial society is not so much the dictatorial qualities as it is the importance of the range of alternatives which the people have. If the water pollution question has the same careful research and development and exploration done on it as we know the SST will have on it, then I have some confidence in the ability of society to make the proper choice. The problem is no one is worried about it. There are a lot of great, huge, industrial complexes interested in the SST. Everyone from real estate developers to big aircraft companies, to the military complex and all that. Not very many people in this country really worry about water pollution.

SINCLAIR: Would you suggest that it is an article of our faith that we believe if people have the proper information, they will vote intelligently?

MICHEELS: We were saying late last night about cutbacks on certain funds for education. Maybe it is a good thing although for a very short while it will be very bad, for administrators to try to figure out what to do. But this might be a means of getting a ground swell through the democratic process and putting the pressure on to even get more.

HASKELL: The continuation of doing things informally is, in my mind, a danger to our country. We do these things--we have a meeting and we all go home. Everybody then goes back to his own business. It's only the fellow who is organized, such as the big industrial people working on supersonic transport, who formally develop policy and then carry it through; who keep having meetings and getting the feedback on what's happening and what do we do next; it is they who get through. That is why they, with their tiny little numbers, have this tremendous power. They have gotten our country to spend hundreds of millions of dollars on the SST. We're like a blundering giant that doesn't know what he is doing with the tremendous power he has. We can't have the brain of a dinosaur, in the body of a dinosaur, and survive.

SINCLAIR: In that respect, with this great problem, it is critical that the public, insofar as is possible, know as much as they can about what is happening currently so they can use their judgment. It's the community deciding whether it wants to put its funds into the SST or something else.

DE VORE: I don't know how to answer that except to say there are some elements you can identify as you examine knowledge and its structure. They are rather pertinent in really understanding anything about the body of knowledge, or a given operation, or technological development. Perhaps primary is not only knowing about it but somehow being able to work with it, to deal with it. With reference to your subject field, history, it's the difference between knowing the chronology of history from a purely historic standpoint and knowing history in terms of all of the related elements--that made history, the political, economic, technological and scientific. Then you see the interplay of these forces and ideas. This should impinge upon how we teach. So I see two things: (1) the selection of what to teach and (2) the process of teaching.

SINCLAIR: The graphs Paul sketched out last night could conceivably, it appears to me, be at the very center of the curriculum effort, not some kind of a tangential concern that would be restricted to certain students in certain categories.

MICHEELS: We had a philosopher friend at Minnesota--one Dr. Robert Beck who is a very able, sophisticated educational philosopher. He always contended that industrial arts should be the core of learning experiences in the junior high school, in terms of the society in which we live. But then he would quickly point out some changes that had to be made in the content. I come back to this point, again from the record, because I think this is the time for you to quit talking about industrial arts and pick another term, whether it's man and technology or something else. The minute you do that you're going to get a lot of cobwebs out of the air, you're going to clear the air for a lot of people who are going to listen to what you're talking about--especially industrial arts teachers--and it seems to me this can sort of be a big push forward.

SINCLAIR: Do you know of any true university context such as might occur today in Wisconsin, Maryland, or a number of other schools, where students are attempting to suggest the immediate concerns they have? It's not outside the realm of possibility that they might suggest something that might be labeled man and technology, or something of that sort, as a reflection of their immediate concern with technology.

HASKELL: It seems to me that whatever the title is, it should have the form and function of a slogan. Man and technology is a nice thing. But Industrial Arts, for instance, has the form of a slogan: the children, boys and girls, are learning industrial arts. Now how can we put it in such a way that the boys and girls go for it--that they feel: This is good, this is mine?

IKENBERRY: I would suggest that this is precisely what's wrong with industrial arts today. It's teaching industrial arts of the 19th century. And it's impossible to teach industrial arts, if there are industrial arts in the 21st century. We don't know how to teach them if we care to teach them. The whole name itself--industrial arts--focuses on skills--industrial skills, industrial arts. I get art medium--art technique.

DE VORE: This is the way the U. S. Patent Office would describe it. They used the term "The state of the art, technique."

MICHEELS: Yes, Wilson's reference volumes on Industrial Arts have nothing to do with the teaching of industrial arts in school. I think we agreed yesterday that there is still a place for young people to learn how to use tools, equipment and processes that may not be in industrial arts; may be in art. We were talking about just a part of all other areas where the use of tools as a learning activity to make it meaningful might be feasible and desirable.

IKENBERRY: There is a craft aspect, I think, in what you're saying. It may not be functional or vocational but may be avocational and aesthetically satisfying.

SINCLAIR: In this context I've been impressed with some of Bernie's remarks which stem from his current industrial activities.

DE VORE. Professor Haskell, I'd like to go back to your analogy. Let me set the stage. We at West Virginia, through some rather fortunate leadership and foresight, came to the conclusion that what was was not adequate for the future. So a moratorium was called for a period of 4 years to study the problem. Let us say that we have studied the problem, we are now 4 years hence, and we are implementing a new undergraduate curriculum. We have students, we have an instructional staff, we have recruited, trained and prepared to teach these students. All of the machinery, all of the men, yourself and this group included, are now outside this sphere just by the very nature of the way things work. This was your earlier point. My intent last night was to indicate that this cannot happen if we want to project to the future. Some built-in change agent must be included in this whole process. This goes back to Elting Morison's book, Men, Machines, and Modern Times, which describes why outside forces are necessary to obtain change. One way we are attempting to change is to have this group come in. You aren't acquainted or associated with day to day activities in the classroom. You come in and observe and identify the changes that need to be made. So it seems that the university, if it's going to serve its function for the people of West Virginia and the Appalachia region, and perhaps nationally, needs to build into the new curriculum a cybernetic model with feedback. There must be re-evaluation, and feedback.

But the evaluators are not the people that implement. They are a part of it certainly. They can explain and provide information, and we need this outside evaluation. Could this be a part of what I suggested last night, the Center for the Study of Human Resources and Technology? One of the functions we are concerned with is technology in society. This group would not be a permanent staff group, as I see it. It would be a group on call, a visiting committee. Sort of a North Central Association that comes in and takes a long hard look at your whole program. Would this do what you're talking about when you say "an elite, trained group" aiding the process?

HASKELL: I don't think it would accomplish the objective simply in that form, because this business of the detached person just giving an opinion and then going home, is not what in the end cuts ice. What cuts ice is the fellow who is determined that he is not only going to give an opinion but is going to see to it that it goes through. And he keeps on and on, and persists. This one-thrust thing is just like having a man at the wheel of his car. He looks and directs the thing, then he goes and watches television or something. He doesn't--he can't drive that way. The guys who see and understand have got to keep on helping and keep on directing things.

DE VORE: Yes, a very close relationship has to be established.

HASKELL: But it seems to me it can't be done just by a group of people coming in and going out. There's got to be a core of people who stay. They can bring in all the necessary people for the feedback they need.

DE VORE: You would have this group as a part of the staff then.

HASKELL: Yes. As a part of the staff, as people who take an active interest. Dael Wolfle, the Executive Officer for the American Association for the Advancement of Science, 2 or 3 weeks ago in Science, had a piece called "Technology Assessment." In it he said that the people of America are becoming aware of the negative results of technology and are becoming more and more concerned about them. He listed a lot of the things I mentioned last night. And he said that a committee in Congress was set up, and had called in a dozen outside experts to try to see what could be done so that the Congress could have the ability to assess the pros and cons of technological proposals that are being brought, constantly, to it. And he said the only thing they could finally all agree on was that Congress needed a great deal more of this. Well it seems to me that the kind of thing you propose here is just the kind of thing that Congress needs--or wants: some way they can assess the pros and cons of proposals--not just to Congress but to each of the 50 state legislatures; also to the municipalities. Everything that has been said at this conference is splendid, and in the right direction. All I would hope is that we could give it a cutting edge, an organizational structure which is cybernetic and would work in the self-intensifying and self-realizing way.

DE VORE: Do you have a suggestion of how we might, with the resources we have now, implement the concept? Last night I said I didn't care to engage in an exercise of futility. What I meant was the concern about establishing something and then finding it's outdated because there was no built-in mechanism for change. As I have indicated to Dean Ikenberry, building a curriculum is an easy problem. But to find meaning, direction and a foundation for that curriculum is essential. And after you have made the effort, at that time, you want to be sure that the meaning and foundation are re-examined. We need to be assured that the curriculum we create to implement the ideas and concepts is evaluated; that change mechanisms are built into it. The issue is critical. Once a structure gets established, it's like a white cast iron; you have an awful time breaking it. There is a human factor in change also. Change is a traumatic experience and an expensive one because you have so much retraining to do. We need to build in some means whereby the individual can keep assessing, and some way to provide the tools, the mental and knowledge tools, to do this assessment.

MICHEELS: Wouldn't it be an important goal, then, whatever evolves, to develop positive attitudes toward change, to accept change, to build on change, to look for change, and to make that a way of a person's thinking and living?

SINCLAIR: Yes. But it is so imperative that you know what is presently real. That's the only way you can evaluate your goals.

MICHEELS: Yes, that's true.

HASKELL: What has been happening here is that this idea, this concept of change and its utilization in the cybernetic system, this process has been manifested by this group. This is the first step. The next step is organizational; that is, to see if we can give it some kind of institutional structure, something that will hold people together and cause them to reconvene with agenda for future meetings, with a program so that, instead of an exercise in futility which we want to avoid, it becomes a beginning of an actual development, self-intensifying and improving.

SINCLAIR: Paul, do you want to tell a little more about this group you mentioned last night? What are your plans for the Center?

DE VORE: Of course I would like to gather some ideas from each of you as to the concept of the Center. My concern is the change element, and the cybernetic feedback mechanism. We need someplace where ideas are dealt with and initiated for trial. We also need incorporated with the study center a center for curriculum development and curriculum resources. We need some mechanism for the publication of texts, brochures and other resource materials for the field. We need a curriculum center where the people in the field can work on the development of curriculum materials. The center would provide resources like Haskell's work and the material developed by this conference on structure and knowledge. This is a vital service for teachers in the field because in their day to day activities they don't have the time to spend or the money available. The center could provide this. It is my belief the University should provide this leadership.

SINCLAIR: This is a permanent establishment?

DE VORE: This is recommended.

SINCLAIR: Then your curriculum laboratory and research center is a permanent adjunct to your program. Perhaps it's desirable that this not be.

DE VORE: Perhaps it should be an outside force and intentionally removed.

IKENBERRY: What you're trying to do is have a big wide scoop so you can keep throwing coal on the fire.

SINCLAIR: A free-wheeling group that, aside from a commitment, has no obligations to the faculty.

IKENBERRY: The key performance would then come from the curriculum group?

DE VORE: Not entirely. This group that would function with the center for the study of curriculum would be a very select group of experts and a very harsh judging group. They would accept nothing as true. They would always assess it from their knowledge as real scholars, raising critical issues and making judgments. However, the study group would provide the impetus.

IKENBERRY: Another way of looking at this is to look at the whole package as the center and then have different elements, different functional elements within the center, and as a part of the center rather than letting the center be impacted from the outside.

DE VORE: What we are suggesting is this. We really never solve the problem. We merely establish a way to continually look at the problem.

HASKELL: We never solve it--it's always new.

DE VORE: I see this permeating the way we teach, going back to your question. You never solve the problem; you never come to a conclusion that is so specific that there is only one way it can be done. If you teach this way, your students go out with this attitude and reflect it as they approach pupils, as they approach school boards, in establishing a program and looking at a problem.

HASKELL: What our society needs is a structure analygous to the central nervous system. It's gotten so our universities are like the starfish, which has no head. As Sir Walter Mobley said in his book, Crisis in the University, the administration, the heads of the university, has been demoted academically: All departments have developed different kinds of notations. The administration really no longer attempts to control, or to direct, or even to oversee the academic work. It is thus more or less demoted to fund raising and housekeeping. It seems to me that with this kind of development we hope to initiate, the president of the university would once more become the academic head who really understands what is needed academically: What courses need to be phased in and phased out, intensified or decreased. The heads of departments--or whoever the faculty people are who are the President's Council--they and the President could see how important it is to our survival. We don't have this central nervous system today, which higher learning must have. It seems to me that what you're creating here is a central nervous system: A central nervous system doesn't itself solve the organism's problems--it helps to make it possible for the organism to solve its problems.

MICHEELS: I'd like to add something else here--this is not a particular topic but John Gardner was talking about the lack of people who go into public life. We are producing the most educated, articulate and brilliant sidewalk superintendents the world has ever seen. He was talking about the greater number of people with expertise capable of analyzing society's problems but very very few with the motivation and stamina to leap in and help solve them.

SINCLAIR: When I first began thinking about the possibilities for this thing, I believe we moved more toward the center of the educational process rather than the peripheral.

HASKELL: What seems to me to be happening is analogous to a chemical solution: you drop in crystal after crystal of solute until it becomes supersaturated. At that point you drop in one more crystal, and the thing crystallizes out. It seems to me these books we're reading--these reports--from all over the country show that there are many people thinking in this direction. What is needed now is to create an organization that will help to pull them together and give our country a clear, well formulated direction. First of all, what kind of structure is needed to make systematic problem solution possible?

MICHEELS: You're talking about this particular area, Bruce? You're not talking about the related education part of it?

SINCLAIR: No, I'm talking about this particular area, industrial arts or man and technology.

DE VORE: I told Dean Ikenberry that if all he desired was a curriculum that this was easily accomplished. All we need to do is look at what is and what is being done. With some minor changes here and there and the shifting of courses and credits, you have a traditional curriculum revision. But what we are proposing goes far beyond and the reason it goes beyond it is this. First of all, the reason there is a similarity between the Minnesota Plan and other efforts is because the men who were engaged in the Minnesota Plan did a lot of the same kind of thinking and the same level of thinking that this group is doing during the 2 days of this conference. We are coming to similar conclusions because we are looking at the realities and the realities for both groups have similar connotations. They come to similar conclusions. It's been 27 years since the Minnesota Plan was published. Over these ensuing years changes and some research have impinged. We now see that what we must do to be honest in the research effort is to start at the knowledge end and identify its content structure--its taxonomy and the various elements of it. I see us going through the identification, the taxonomy, the synthesizing of these elements so that we can identify elements that fit together logically into teachable content. The one thing that we haven't done in our field is to go back and deal with the content area as an intellectual process and technology as a development of mankind. Every subject area has certain modes of thinking, and these are the processes used to accumulate knowledge, to evaluate it and to change it. As Mr. Haskell noted, you have a theory that works for a period of time, you accept it but you are continually evaluating it. This concept has to be built into the scheme and then the teaching process. This is necessary, because we are going to be working with a number of levels of groups, which again Professor Haskell has so well illustrated to us.

We must also be concerned with making it real. We have to study the theories of learning, how they contribute. Then we have to implement the curriculum itself. But to implement the curriculum we have to look at physical facilities because of the doing aspects of technology. Technology is tool centered; it's activity centered; it's problem centered. What kind of physical facilities and laboratories do we have to have to implement a given learning environment? Each of these elements require investigations. Many of the answers will be ones that we already have, but we can't accept them carte' blanche'. We have to go back, re-establish, affirm our faith, that these are right answers.

SINCLAIR: Yes. It's a case of tool-centered kinds of activities, and instruction; if your taxonomy suggests a study in the sense of tools and their functions, it's essentially a different approach than tools that have been used in the previous industrial arts concept. You'd have to re-structure not only your content but your physical arrangements.

MICHEELS: I refer to the Minnesota Plan. There are several cases here that relate to this. Part of the plan was an attempt to fit something new into the ongoing, except that those activities related directly to industrial arts, were to be completely new. We were trying to bring man and science and technology together. We did get to the point where an engineering mathematician spent a year, part-time, in inventorying the mathematical concepts that a teacher would need. He left out those concepts that a major in math would need, with a provision that if a person suddenly decided he wanted to go into mathematics a tutorial seminar would be provided to give him those competencies.

Now since I've been at Stout, a group of people, some of whom were with me at Minnesota, started talking in a different direction--more sophisticated and we have to this point set it up alongside the traditional curriculum for the 1200 students in industrial education. We couldn't stop, or I didn't propose to. But this is going on--the development is going on completely separated with the development of completely new courses.

Where you're going to run into difficulty is trying to make all the experiences they have in the technology curriculum correlate with courses in communications, mathematics and the sciences. How can they be blended or are they going to be taught the same old way to people who are going to major in chemistry, physics, or mathematics?

DE VORE: We have this problem with economics.

HASKELL: It seems to me this could be put in train the way I described last night: using the unified science concepts we've been developing over the past 27 years, the university president, trustees, and deans providing the sponsorship. The various faculty members who are interested in synthesis would be brought together in a study group over a period of a few months. As they develop ways of bringing the sciences together, you develop a President's Council. The President's office thus becomes the academic controller and guider. The university thus resumes the function it had in the middle ages when the President or Rector was a divine, and theology was queen of the sciences. At that time he controlled the various members of the faculty. This isn't a question of developing dictatorial powers; it's a question of developing the kind of organic structure in the university which permits it to function as a hierarchy.

MICHEELS: I agree. And another example outside this field is our art department. Some of the things I have been talking about in our art department which we've tried to give a push in the past few years. They've come up with a very radical, completely different approach--no marks in the traditional sense. They have a proposal they've thought through very carefully. But they're running into a stumbling block. They haven't been able yet to get the people who would have to work with them. They're willing to work but some of the other departments, to this point, have not been willing to work with them in a different way in a different approach. Until we get that, my experience indicates there is no sense in wasting a lot of effort until the people who are going to be a part of it are committed to doing something differently. You ought to be getting your interdisciplinary people in on this program right now. This is an experience I learned during the war in terms of any kind of a proposal. I learned a great lesson when I was in the Office of Defense Transportation, where the head of our women's department had a broad plan for training women for the transportation industry. Weeks and weeks of planning went into this. But one important dimension she missed. She forgot to call labor in when she first started out. After the master plan was laid out, labor said, "Oh, that looks nice--we won't do it!" So this has been a lesson to me all the way along.

HASKELL: Have you no professors or teachers in the art department who are interested in technology?

MICHEELS: Oh yes they are. I'm talking about outside the art department.

DE VORE: Cooperation of other departments.

MICHEELS: Cooperation with other departments is the very thing I'm talking about so I can agree with your thesis completely.

HASKELL: One thing that happens is this: If one can find one or two persons in each department who are interested, the others begin to see how the wind is blowing and begin to reassess their own stubbornness.

SINCLAIR: Edward, I know the problem that you suggest is the taxonomy, which might very well reveal a similarity when you approach this problem in terms of large general concepts that reveal similarities--chemistry, physics, biology, economics, history and so forth. Doesn't this accomplish a kind of synthesis?

HASKELL: It doesn't accomplish it, but it helps to put it in perspective. It doesn't actually accomplish it because the description of the world is not confined to any single conceptual structure. There are many different conceptual structures besides the general one. This is the way the world is. You deal with these realities and do the best you can. It seems to me it's very much in the right direction.

SINCLAIR: In a way, isn't that the one critical part of this kind of a program, that it does come at what we have been calling industrial arts, but with a different attitude?

HASKELL: One reason I was so delighted with the industrial arts level of this conference is that that is the thing that will bring together the great mass of students and teachers: We're all in industrial arts in one form or another. We all work at home in repairing things, and building things. We all have this in common, and it's essential that we work on the level that we have in common. We can go up higher and higher to levels that we don't have in common, but as long as we have our feet on the ground we can hope to stand. Otherwise we can't. We can't do it just from the top down. It seems to me it also has to come from the bottom up.

MICHEELS: I still come back, Paul, and find out why you are so extremely reluctant to be drastic now in terms of a name. I would be interested to know why the reluctance to make this name change.

DE VORE: Are you asking why we continue to use in our study the term industrial arts rather than to concentrate on the new conceptual structure of man and technology and all this implies? I don't believe I am as reluctant as I have been. This was one of the reasons for bringing this group together. It was to have them assess this point of view. I thought this was necessary in our profession. I feel this assessment must take place on other than a personal basis. I'm not defending the apparent reluctance. I came to this group not defending anything. I had to take this attitude but by the same token I must prepare myself, when I make a presentation, to see that I have researched it and have some logic to it. Then we can move ahead.

This is what Professor Haskell said when he knew he was going to present his paper in December. He wants to present it to a group of scientists so it can be criticized and he can move ahead. That is essentially what we are trying to do here.

Because of your support, I think I can now justifiably move to the next stage. We must come back, however, after we get all the content, taxonomies, intellectual processes, teaching processes and learning units developed. We must continually reassess. This is the cybernetic approach. And this must be the attitude we take with us into this project.

MICHEELS: What I'm saying is that in 1904 a man wrote a rather short editorial and tacked on a new name called industrial arts. Ever since that time we have been stuck with it because it did have a nice sound. Then we've been spending all this time trying to justify some things but now we're not quite sure what we're trying to justify.

SINCLAIR: My impression from what you were saying is that by calling it man and technology we are liberated. We reject, almost implicitly, many of the connotations of the term industrial arts.

MICHEELS: My point is that he hasn't done that yet--he's reluctant to do that.

DE VORE: I'd like to make one other comment in terms of a name, and that is this. My rejection of the term industrial arts is that it leaves out the human connotation, whereas if you use man and technology, you always must be concerned with the human. I coined the term and many people said, why you're talking about humanities when you deal with this. I said yes, but with a difference--it's more techmanities, techniques created by man. This has relevance to me. So there are a lot of possibilities on what you mean. The name must have meaning, just as you assign botanical terms to plants to give meaning.

SINCLAIR: Bernie pointed out that there are certain discontinuities brought about by rather remarkable technical advances in electronics, but the point is, man is continuous--he is not discontinuous.

DE VORE: I would like at this time to know what you think the scope and limitation of this future research is.

SINCLAIR: Are you speaking with reference to the group at the top of your chart?

DE VORE: No, I am speaking about research we are engaged in creating a new undergraduate curriculum. Do you foresee, for instance, that this should be limited to undergraduate programs or should we move on to our masters and doctoral programs? Is this necessary? Maybe we've already touched on the major problems. I think what I'd like to do in the limited time we have is to focus attention on that latter one now--resource personnel.

SINCLAIR: On this matter of resource personnel, are you thinking of specific names?

DE VORE: Yes.

SINCLAIR: Is Kranzberg's name on it?

DE VORE: Yes, he's a member of this group in terms of a steering committee.

MICHEELS: Another person who would be good and probably you should talk to--I don't know that he would take the time, maybe you have talked to him, is Marvin Feldman of the Ford Foundation.

DE VORE: Yes, I know Marv.

HASKELL: Harold Cassidy is another one.

DE VORE: Yes, I have his address, but I'm glad you mentioned him.

HASKELL: He's a member of the Council for Unified Research and Education.

MICHEELS: I don't know if Hunter Shirley would make a contribution in terms of technologies as such. He might have something to contribute on systems.

DE VORE: And human behavior, and learning.

MICHEELS: Yes, he has models for all of these. He loses me after the third or fourth page, but they can plot all the emotions through and they've got all these factors that may have some meaning for you in terms of your processes and organization.

HASKELL: From the paper you sent me of his, I would judge that he is doing a very good job within psychology, where there are so many different schools. He seems to know very well how to speak to these schools and pick out those things which will fit and thus give them a branch from which to climb down and in the end form a coagent coherent.

DE VORE: What about the field of history of technology? Layton has agreed to help us. Kransburg has agreed when he has time.

SINCLAIR: The thing about Kransberg is that he makes connection with so many other circles.

DE VORE: That's right. He is as close to being a universalist as anyone I know. He is an historian who has rejected many of the points of view of his own field because of the elements of this area of technology.

SINCLAIR: I could give you a number of names in that field if you'd like me to do so.

DE VORE: All right.

SINCLAIR: Do you have anyone who has experience in government?

DE VORE: No, I'd like to have some recommendations there. I have some friends at the Smithsonian. I attempted to get Holloman who is now President of the University of Oklahoma. He was former Secretary of Science and Technology at the Department of Commerce and has spoken out on this and the relevance of educating the masses and spending money in certain public sectors in the technological endeavor to improve the way of life versus pure research in the study of science. He has an empathy or an understanding, after seeing this field in action. This type of individual I would like to have on our team.

MICHEELS: You might think of Dr. Athelstan Spilhaus.

SINCLAIR: The science exhibit at the Seattle fair was remarkable.

MICHEELS: He had charge of that.

DE VORE: How about in the field of economics? Is that a field we should have represented?

SINCLAIR: Stewart Bruchey at Michigan State might be a possibility.

MICHEELS: I think you've a report to make, Bruce. We do have some specifics, although we wandered a lot but this too is good.

SINCLAIR: Now do you mean for me to include these names in my report? In my verbal report, or written?

DE VORE: In the verbal.

Friday Morning
November 10, 1967
Group 2 - Discussion
Dr. William Drake, Chairman

DRAKE: This is group 2. Bernie, would you like to indicate what we discussed yesterday?

MULLER-THYM: We began actually by making statements addressed to paragraph A on the Educational Needs of the Individual and Society. 1. Among those needs it was suggested there were needs that might be met by some revised curriculum in industrial arts. It was suggested the program give the students some of the language, some feeling for the modes of association, transactions among men, and so forth, that are characteristic of their work in an industrial society. Technology is a dominant element of a culture. 2. Secondly we discussed the need of understanding the environment. We were concerned that they be able to purchase intelligently and understand the nature of the society. If technology is the foundation of industrial arts, we have the task of making people literate in terms of their technological environment. To add to the comment, every civilization from the Summarian one to this day, has been affected by citizens tampering with the environment in which they live. They didn't understand the seriousness of the relationship between man and his environment, and in the process they may have destroyed themselves, civilization, and so forth. So it's imperative that each citizen learn something of the relationship between technology and his environment. 3. What are the educational needs of individuals? To teach students how to adjust to change. There was a fair amount of comment resulting in the suggestion for one of the courses as a component of such a program, the study of the history of the methodology for bringing about change. This relates both to the management of change where technology itself changes resulting in an invention and in business in our society with the requirement of bringing invention to the market place. Also bringing about change in some institutions--like a political order, an organizational structure, or something of this kind. There is also the problem of understanding the process and its impact on the individual himself. Suppose some change of behavior or conduct would be considered to be desirable. Are there means of putting the individual in a position where he would be more likely to change in a wanted direction than not? These were some of the statements of needs.

We did make some comments about trying to understand the individual markets of the future. For instance, will the prediction of abundance for the year 2000 be completely wrong? So, I think it is simply a restatement of the need for helping the individual understand his relationship and that of institutions and of technology to the environment.

A few other comments which were really not expansions of the educational needs of the individual but which have to do with the desired elements of a program and some of its purposes. What might be building blocks for course content and the rest. I'll just introduce these piecemeal.

One of the purposes, for example, in a program like this would be to introduce an understanding of uncertainty. I took it that this meant uncertainty ranging all the way from the nature of probability, the kinds of probability that exist in freedom, uncertainty as this exists in the world of science and technology, to the kinds of uncertainty that Heizenberg talked about.

We said also that given a program in industrial arts such as we are talking about today, there surely should be courses in the history of science and technology. There might be another course congruent really with systems as such because we live in a world where not only are we ourselves a part of systems but human artifacts more and more have the character of systems. We have weapons systems, defense systems, missile systems, ecological systems, and so forth. We are now designing systems much more than we are the single component. A friend of mine says that today's system becomes tomorrow's component. That's certainly true. So this would be a course. One would not start out with a set of theoretical statements at the level of abstraction which Ed, for example, has arrived at. Rather we would take students through an examination of systems, many different kinds of systems, so he would understand their inter-dynamics. Then from this, by way of induction, we could begin to make statements about the general characteristics, laws, and theories about systems. In the same way there could be a course dealing with change. This would consider the processes of change and whether a given change had been successful or had aborted in some way in different epics of history. This would be confined not necessarily to technological change. A technological change, in the way it usually occurs, comes about so the people who are involved in it view it simply as a replacement for an older way of doing something. In this way, for example, the telephone, as Alexander Graham Bell set out to invent it, was to be a replacement for the telegraph. He did not know that he had invented it. Neither did Elijah Gray, who was the co-inventor, realize they had invented a completely new medium, with completely different characteristics. In the same way, the computer, in its early days and to a great degree today, is looked upon as a way out. The people at IBM looked on the computer as a way of processing a volume of classic transactions, like payroll, the accumulation of costs and things of this kind in greater volume, with greater rapidity and more accuracy. In the process they simply missed the whole genius of what a computer is. And so usually we do not know where new technology hits us and except for a few enlightened people in society, we do not know what the meaning of the thing will be. One way to do this might be to introduce them to the technology of the "T" group. At any rate, exploring sort of the natural history of things, particularly where technology is involved, is important. Are there any lessons, even with the rules of thumb we have, that will enable us to get on top of the process, to manage, control it, bring it about in some desirable way and so on?

There are a number of current examples of this. For example, how is action brought about in the political community? One of the phenomena on the American scene which political scientists are interested in is the disappearance of the boss. In some American cities there are some traces of the boss rule but these are disappearing rapidly. Today in a community the way you get action is by having maybe a hundred different centers, all represented by people of achievement and of multiple and variable excellence. They form a whole network of interactions, the result of which brings about change. So, the organization of the change-making systems, which are societies in themselves for this purpose, would be content for such a course.

There was some discussion, inconclusive, about a name for this body of knowledge. I don't think it's important to record what we did here. In some part, I guess, without knowing what ground had already been covered by Paul and Tom in their work up till now, we considered some characteristics of the future programs. We remarked they should be open ended and self-renewing. This would reflect the character of industrial arts in continuing education.

There was discussion, useful I think in some ways, of how to mount such an activity in terms of what we were discussing, as well as the things presented last night and the implications of Paul's and Ed's statements about where would one get a faculty? The suggestion was made that we think of a very small core faculty. Over a period of time, the process of introducing young faculty would establish some flow in and flow out.

If we could combine an approach to teaching in which there would be massive inputs for short and significant periods of time around organizing ideas, and then develop, through the framework of a budget, the potential of being able to bring people from anywhere in the country--or from abroad for that matter--who would be resource people, to lead discussions and provide such inputs. In the course of a term or an academic year, one such person might have made 3 visits for periods of 2 to 2½ days to the campus and there might be 10 or 12 such people during the year. Meanwhile, work would be organized in seminars so that the students in the courses who in practice in a practical society have to get credit, would read from a pretty bizarre reading list and organize their own discussions, using core members of the faculty to do this, as well as using any other resource people. Are there some points that I missed that we should include?

DRAKE: I might add the notions of creating some "carrots" for the visiting faculty--i.e., structuring an experiment which would measure the effects of the curriculum changes.

DAWSON: On the content reservoir, we mentioned that "life guidance" would be an integral part of this program, or probably should be. Another is that the people involved in this activity in school should be the ones who are analyzing this problem of world abundance--or lack of world abundance--or being able to take care of the emerging, increasing, growing, population with the products of technology, whether it be agricultural or otherwise.

In a general area, we mentioned that technology should be a background or fundamental program in school for all students, regardless of sex or regardless of their occupational goals or of their inate ability.

MULLER-THYM: I didn't mean to omit that one. I jumped over it to include something else and forgot to come back to it.

DRAKE: Maybe we should now start to react to some of the inputs that we have had since our last session, both Paul's presentation and Mr. Haskell's presentation about unifying or synthesis. It seemed to me that one of our responsibilities to Paul was to attempt to ask some questions regarding potential goals and to structure his and our thinking a little bit more. I feel rather strongly about that.

ALLISON: I don't know, Bill, what your thinking process was in arriving at the feeling that we had that need. I felt it too, but maybe for a different reason. New developments in any area--education or any area--are not likely to happen from within. I don't mean that developments cannot be *conceived* from within; they more likely are than not. But they are less likely to become *reality* unless there is some external force at work to help them along. For that reason, I feel that some statement of mission or goals, even though oversimplified, is necessary, so that the outside world has some feeling of what's going on. I think it would help the cause if we were to talk about these "straw" goals, or whatever we wish to call them. It might help Paul and Tom in their efforts, if we had some discussion of what those tentative goals might be, or how we might describe them.

MULLER-THYM: May I ask a question? I'm not expecting any answer, one way or the other, be it yes or no. Would you say that the goals for teaching, whatever this program in industrial arts would be, would be different from the goals for teaching science in high school?

ALLISON: I think so, yes. A modified yes. I think one of the important goals in teaching science in high school is certainly the same as this; that is, to produce the "educated citizen." But another, also quite important, is the hope that some of those being taught are going to become so interested in science that they will want to go on and pursue science as a career. For that reason, a program in physics or chemistry must be deeper in those subjects than a course in the history of technology must be deep in the technology.

MULLER-THYM: Let me ask another question here. You don't mind, do you? I'm trying to approach this from another angle completely. Would you say in high school that one teaches physics and not about physics?

ALLISON: It seems to me, from my limited knowledge of the "new physics", that some physics is indeed being taught.

MULLER-THYM: But we might teach about physics at the same time.

ALLISON: Oh yes.

MULLER-THYM: Well in a course in industrial arts, would one be teaching technology or only teaching about technology?

ALLISON: I would think about technology.

MULLER-THYM: But I think technology ought to be taught. I don't know the answer.

ALLISON: In high school the technology that is taught is taught in math, in physics, in chemistry. It is too early then to expect to do any significant amount of teaching in technology.

DRAKE: I think I disagree. I was struck last night as Paul was presenting some of the slides concerning transportation, communication, and so forth, that this was a functional analysis. But then when he got into the industrial manufacturing and production processes, it looked to me it could have been a business administration text.

MULLER-THYM: And then taught at a second-rate school. It wasn't really a regular standard approach in a good business school today.

DRAKE: Yes, that's why I would say it sounded like a business administration text. It seems to me that the "new industrial arts" might be able to provide an understanding of the industrial process through an understanding of the forces that are at work in the industrial situation which bring about change. A high school student who is not going on to college could be provided with a framework in which he can understand the forces that are acting upon him. That involves understanding the industrial process. And the forces that are at work in changing that process. Some curriculum development research going on at Michigan may provide an analogy. The question is, how do you train vocational high school students for office work? You can imagine the list of vocational activities that could be offered. The experiment, however, has to do with comparing the traditional method of education with the new method. The new method is to study offices as a system. The hypothesis is he will acquire more flexibility in shifting from one function to another within the office environment, by understanding his job in relation to other information processing jobs within the office.

DAWSON: I wonder, as we think in terms of content and direction, just how involved we should get in a person's future--his goals. You've mentioned the area of training or educating office staff, at the high school level. This can be done--to a degree. However, when you employ a person who has been educated this way, you expect to get the output just about equal to the input and that's about the end of it, I think, unless one can continue the educational process after being employed. In the past, industrial arts has been largely concerned with occupations. And the industrial arts laboratories are where our students can go and actually get involved with machines, tools, materials, and equipment. Students learn some processes which they can take into industry or they can take into an engineering or science program in college. I don't think we have come to grips with the question, "How involved should this new industrial arts be in relation to what a person's goal in life is going to be?" Maybe we should discuss this a little bit.

ALLISON: I would think an industrial arts program would incorporate what one's life goals are going to be. The program ought to open the youngster's eyes to possibilities in the world that otherwise he may only discover when it's too late--when he's beyond school or beyond the point in his life when he can get more education. I suspect most youngsters of high school age, unless they're fortunate enough to live in an environment that exposes them to life choices, don't know what their choices are. If they get centered into a terminal kind of program, in industrial arts or whatever, they often never know what they might do or how they might grow.

DAWSON: Are you saying that this program of industrial arts should serve as a guidance function?

ALLISON: I am.

DAWSON: I think this is very important to Paul's approach.

ALLISON: I don't think you can train a person adequately, a couple hours a week for a couple of years at age 16 and 17, to be a computer programmer or whatever; at that moment in his life, he thinks he might want to be. By using those two precious hours of the day, you're using a lot of time that you might otherwise use to expose him to a lot of other things. Now this sounds as though my idea of industrial arts is a kind of a surface-skimming, a shallow thing, and it is! If you're thinking of technology at this education level, it almost has to be a surface-skimming, because technology is a lot of disciplines brought together; one can't begin to be a technologist or engineer, and maybe he shouldn't begin to think about being one, until he's older than high school age.

MULLER-THYM: Would you see this program as sort of an opportunity for a synthesis, like Ed's talking about, for a synthesis of the other programs in high school? In other words, could this be the kind of a program a student would take and it would attempt to make his science, his math, and so forth, realistic or more related to the world of work or the world of his existence as he leaves high school? Is this too much to expect? Is it too shallow? Is this what you were thinking about, David?

ALLISON: I don't know if synthesis is the word I would use, but I would use the word survey, or appetite-whetting.

DAWSON: I frankly think there's nothing wrong with considering courses that have more breadth than depth.

You wanted to use the word shallowness here. I think people have to understand what there is before they can understand what it's all about. And maybe this is one of the goals of this new industrial arts.

MULLER-THYM: This hasn't been the way it's been done, you know. We start them out in a chemistry class and we give them a little bit of chemistry. Then they go to college and they get more chemistry, then they come back for graduate work and they get more chemistry. And then they start to teach chemistry in a university and they start the process all over again. You see, they're just perpetuating chemistry, chemistry, chemistry, where there isn't any relationship. What I was thinking was that maybe, as long as these are the facts of life, where the process is subject matter centered, and as Ed puts it, they become so expert they can't do anything but renew themselves or they don't want to do anything else. Maybe there ought to be a course that would do this for the student. Maybe this isn't the right way to do it. Maybe this is just an intermediate step. Maybe we ought to get to the point where each one of these subject areas does it for itself.

DRAKE: The development of a product, or a system, is a synthesis process. It's a process by which many disciplines are brought to bear on a particular goal--namely, fulfilling a market need. When I suggest an understanding of the forces of the industrial process, it's in this context that I speak as opposed to the business administration textbook approach to the factors. The more I think of it the more I feel it may be a key to helping the student understand his environment, his relationship to his environment and the forces of change that are going to be affecting him the rest of his life.

ALLISON: I like the idea because it adds a note that might otherwise be missing in the shallow program I'm describing. And it adds a note of reality. It adds (1) the inevitability of change that we've all talked about and (2) the reluctance to change that the creative person feels. Nothing is so despised as a new idea. Nothing is so likely never to have any impact on anything as a new idea. In thinking back over my own education, I don't think I ever learned this. I thought the apple dropped on Isaac Newton's head that day and the next day the whole world of the solar system opened up and everybody understood everything. But if the program of change could incorporate some of the human element, I think it would enhance my prototype program considerably. We think of the old "better mousetrap" idea, I know, and we believe if you build one, the path will be beaten to our doors and all that nonsense. It just doesn't happen that way in real life and, furthermore, many good anecdotal teaching devices can be brought to bear in such a program.

DAWSON: Tom and I are at a great disadvantage here because we have studied the field as it has been, although neither of us agrees with in many ways. But there is something that keeps coming to my mind. If industrial arts has the merit that we seem to suggest, it's going to have to be a continuous process from the beginning of school life, through higher education. What will we do at the elementary school--the primary grades, the intermediate grades, the upper grades? What will we do in junior high school and senior high school? And what is there for industrial arts as a service, at the university level? We seem to be implying that this can be done at one installation service. If technology is as important to life as is science, which we start at the kindergarten level or at first grade, and move upward, then what do we do at the beginning of school life in industrial arts and how do we build upon it as we progress through the 12 grades?

DRAKE: The only real example that I have is the grade school that my kids are attending. Starting in kindergarten they have a social studies section. At first the focus is the child and his family; then the child and his relationship with the school and then the child and the school and the neighborhood. By the third or fourth grade horizons have expanded to the child and the city and then to the state in an ever increasing geographic and social expansion of the child's environment.

When I think of the new industrial arts I have that analogy in mind. Is that fair?

DAWSON: I suspect it's true. I think the expansion here is in terms of life processes. Technology is an integral part of the continuing life processes of everyone. It would seem to me that there could be a core of studies with technology bringing together the sciences and the humanities through the socialization processes. This core of studies could expand itself from one grade to another. Industrial arts hasn't gotten involved very much in the core curriculum of the primary or the elementary grades. It's been used mainly in the junior high school--grades 7, 8 and 9.

DRAKE: The notion of change should start in kindergarten. But I don't know about the industrial process itself. That's a pretty complex phenomena and there are many different aspects that require understanding.

DAWSON: Let's take the hardware of technology. Students cannot understand, in my opinion, the complexities of the industrial complex or the technological happenings unless they understand some of the hardware that is employed. How much of this can a person learn in a certain amount of time? Should he start learning some of the hardware as he goes along? Maybe it should be coordinated with organization.

BRENNAN: Before we answer that question, I might ask another one. Is it necessary they know the hardware? Is it important from the manipulative standpoint, and personal or physical contact?

DRAKE: The specific hardware they study in second grade is going to be obsolete before they use it as an adult.

DAWSON: How about principles and concepts?

DRAKE: That's a different matter.

ALLISON: I was thinking, as the word hardware came up. My first feeling was no, that gets too involved. But on the other hand, the fact that it does exist, is touchable, if not understandable--at this age, the fact that it does exist and is available to be fooled around with, ought to lend some reality.

BRENNAN: The industrial arts people have believed that one of their chief assets has been the fact that they can deal with their subject matter kinesthetically as well as orally. What I'm implying here is that it's quite possible that this could be a purely picture type experience--lecture, workshop, or whatever it might be, other than a doing aspect, you see.

ALLISON: You can do some marvelous things. Charles Eames designed a series of shows for IBM to sort of "humanize" the computer. I can remember watching my children standing in front of a Sherlock Holmes puppet show; the point of the show was to be amusing and to give a little idea what a computer was all about. They were enchanted with the show, they got the message, and the word "computer" from now on, I think, will not be a scary word to them.

BRENNAN: This kind of experience is a vicarious experience. What I'm trying to explore is your thinking of the value of the kinesthetic approach. Should the kinesthetic approach be included?

DAWSON: Industrial arts has been, since the beginning, largely an activity program taught in laboratories, primarily. Sometimes it has been completely in the laboratory without any classroom work. I have suggested to others that one of the reasons industrial arts has grown as fast as any curriculum area is because of the activity element of the program. But I believe that one of the reasons industrial arts has continued to grow and be accepted as it has is not because of the content it has offered the children's mind, but the place it has offered where the students could come in, release their tensions, and express themselves creatively and solve a few problems themselves. Industrial arts has provided a place where children can train the mind as well as the body. They can be creative without the principal saying, you're making too much noise, But why should industrial arts be assigned the task of providing freedom and activity in a problem-solving situation more than any other field of education?

DRAKE: Maybe a new industrial arts curriculum is sensible only in the face of important changes in other parts of the curriculum.

MULLER-THYM: We've come up against this in 3 or 4 ways--yesterday as well as this morning.

BRENNAN: In a way, it is happening. We've had the new math and the new sciences and these have been more activity oriented than they had been before. They aren't the series of mental exercises they used to be. So maybe we're just in step with the reorganization. Some of the things they are doing we have been doing for years. So now maybe we're at the point where we ought to backtrack a little bit. I don't know.

DRAKE: Do you mean to introduce some of their elements that you haven't emphasized and focus on the industrial process and understanding of the forces of change in society?

BRENNAN: What kind of balance should we maintain?

ALLISON: Don't lose the materials or laboratory, or whatever you call it. I don't care whether you keep English, history, of what have you.

BRENNAN: As Ken has pointed out, up until now it has been a laboratory course--the students come into the laboratory, stay in the laboratory and leave the laboratory and never get to a classroom. And I would say this is true in 90% of the cases. Newer trends seem to develop either a classroom within the laboratory or a separate appendage to the laboratory where students can get more instruction in theory and principles and concepts.

DAWSON: The seminar approach has been one of the additions to the laboratory wherein students come together and discuss technological problems. Here students do an in-depth study of a minor research problem and then come together to make presentations on what they have found. This is good. We need a balance between that which we do in the laboratory and that which we do in a more formal situation. I would not like to see us get too far away from the laboratory. On the other hand, too often the laboratory is an excuse for doing too little.

BRENNAN: Then too we face the problem that the people who teach industrial arts are gadget minded. They wouldn't have gotten into it if they weren't. You can go through any industrial arts laboratory and see equipment that has been bought because the teacher liked it--made it, or designed it. The equipment manufacturers have capitalized on this and sold us a bill of goods for the last 50 years. At a national convention you see sophisticated equipment duplicated, except for size, from the design of industrial equipment. We have gotten into the position of believing that we have got to have more and more of this sort of thing.

DRAKE: Would you say that the person attracted to industrial arts is a person who all these years wanted to have the best shop?

BRENNAN: Yes, and he has the world's largest erector set. We have gotten ourselves into such a bind we think we must have this equipment to do the job.

MULLER-THYM: Well the modern equivalent of this is the guy on Project MAC who has a console in his apartment and he won't move away from Boston because all at once he realizes he can't get up in the middle of the night and talk to the computer. It seems to me we're still beating around the idea of content and Olsen in his analysis of technology and industrial arts alludes to 6 basic functions that industrial arts is obligated to serve in order to fulfill its purpose. The six functions are: a technical function which we've talked about considerably--Dr. DeVore did last night; he adds to it a consumer function which we've mentioned but haven't pinned down anything on it; a social function, a cultural function and a recreational function. Is that all of them--technical, consumer, social, cultural and recreational?

BRENNAN: I've got 5 but that's all right.

MULLER-THYM: Now is it really that big? Should it include all these?

DRAKE: The ability to express oneself with his hands and make things in a creative vein, rather than in a "build a Heathkit" vein, is something we haven't talked much about, and it's something that Ken mentioned in the very beginning.

DAWSON: There are surgeons and dentists and people of this nature who have told me that the greatest course they have had, bar none, was an industrial arts course. The type that we have now. They had a chance to build dexterity and understandings of levers, mechanisms, tools, and what have you. Certainly dentists know how to do that.

MULLER-THYM: I wouldn't object to this too much if in laboratory you had some numerically programmed machine tools and enough of them--a sufficiently large family--so that you could simulate a factory which is making something. Or where you go down and create program tapes or work at a console of your own, or be introduced to some of the post stone-age technologies. I wouldn't object to that at all.

DAWSON: Let us consider closed circuit television which is coming very rapidly into the educational program. The industrial arts teacher of today doesn't want to get involved very much in the use of it--he wants to build the apparatus. He wants to put the instruments together and make them work. He doesn't care what happens after he gets it all built; it's a beautiful job and picks up a good picture. He usually stops there. But I don't think he should stop there.

ALLISON: He can take it apart.

DAWSON: Oh yes, he can take it apart and put it back together; a beautiful job too. He knows how but does he know why?

DRAKE: Changes in curriculum require changes in orientation of participants in the field. The reason why industrial arts attracted a particular type of instructor is because of the way it was defined and involved certain activities. If it had a different definition or a different set of activities it would tend to attract a different type of person.

MULLER-THYM: It parallels what has happened in the industry in the making radios, phonographs, television sets and so forth. Typically, if you go through all the companies, and there are hundreds of them around Chicago that do this sort of thing, including Motorola. They have very few engineers--people with formal engineering training. Nearly all are people who like to fiddle around with equipment. They learned a little as they went along and then got into a kind of intermedia state.

BRENNAN: We have an area in education now for the training of this kind of person. This is why I was reluctant yesterday to stop at the acceptance of the word technology because at the present time these are called technology programs. These new programs have mechanical technology, engineering technology, electrical, electronics technology and others. This is the middle man--between the engineer and the factory worker. This is the guy who has today what used to be an engineering background.

DAWSON: But this is a misnomer. It's a label that's been applied.

BRENNAN: Yes but it's accepted. And this is what creates our problem. We use this word technology.

DRAKE: But there is a technology of industry as opposed to a technology of products.

DAWSON: Am I wrong in this? I'm not sure a person who can beautify hair or repair a radio or can take an X-ray is necessarily a person that understands technology.

IKENBERRY: We get the point. Tom keeps claiming I was scared in 7th grade by letter holders. The move is from a letter holder to an X-ray machine, you see; instead of simply teaching me to make a letter holder. If he had been teaching me in the 7th grade the intricacies of the X-ray machine, he still would have missed the mark. In the cardinal things I'm concerned about in industrial arts one is just as irrelevant as the other. When you get down to the micro low at that point, particularly in the early grades, you lose the point of the whole thing.

MULLER-THYM: Technology really is an intellectual process. And the reason we were talking about it yesterday as having any valid place in a curriculum that might be taught at New Trier was exactly this.

DAWSON: That's my belief as to the direction industrial arts should go too. And that's Paul's presentation as I heard it last night.

DRAKE: And if it isn't that, then something's wrong.

BRENNAN: Is this an entirely different kind of an approach than what we've had up until now?

DRAKE: Yes! It's the rationale of organizing the activity of man with respect to the making of things.

BRENNAN: Dave says we don't want to lose the aspect of being able to make things.

DAWSON: No, he didn't use the term, make things. You can understand the process without making something. You can understand the principle. Take a very simple example, the principle of turning, which has some place in technology. One certainly doesn't have to learn how to turn on a wood lathe, a metal lathe, turn down an armiture, or plastics, or anything else to learn the principle of turning. But it has a place, an intellectual content, of the know-how and the understanding of the why turning is essential to the industrial progress. One doesn't have to make a project. Or probably even go through the process, although I think we should go through the process.

BRENNAN: There's the issue! You think he should go through the process, at least once. But is it possible for him to simulate the process?

MULLER-THYM: He ought to go through some processes though, and this would be enough to keep him alive, in contact with the wheel, duplicate the experience of his predecessors. Now my arguments, which do not at all contradict Dave's position because I'm with him on it, is that this should be done in such a way that a generalization can be made. Let me make a couple of generalizations for you as examples. Take the technology of warfare. The typical stone-age weapons, the neolithic weapon, is a knife. With this being held in your hand, you can kill the enemy next to you 2 feet away. Next you now put the knife in a stick 6 feet long. With this, you can kill a guy 6 feet away, you can throw it 10 feet. Shorten the stick and put it in a bow and you can kill from 100 feet away. Shorten it more, change the flint to metal, put it in a cross bow and right away you have increased the range another 100 yards, with some increase of accuracy. I now take the stick out again, put the metal in a tube with a charge of gunpowder behind it and I can go on increasing power, accuracy, and rates of fire. In this whole process I am trying to approach universal, total, instantaneous killing. But I never get there. And you go various ways for example, the British Square, the mass firing tower and things like this. In all neolithic warfare one kills the enemy selectively and individually. Our typical post-neolithic weapon was total, rapid, instantaneous. I could parallel the history of weaponry with the technology of armor. Armor gets heavier in order to protect oneself from the increased power of weapons. Then when it ceases to do this, you take all of it off and go naked again. Protection then is in swiftness. So you have pulses like this that match other pulses in the change of weapons. Let me give you an example from the technology of processing information with machines. In punch card equipment, sorters, collaters, and counting machines in the 400 series, not the 600 series which is the electronic multiplier which is something quite different, all of this belongs to the age of the wheel. All electricity is used for is as a source of power, to create circular motion on a decentralized basis. It is used to take a reading by a brush and to make contact through a hole in the card, by a wheel or a cylinder, and to carry an impulse through a wire to a solenoid which turns over a counter and a type bar. Everything that is done, the entry of the information prepared by classifying it in the files, the entry and the processing cards, depend upon where a wheel is at some time during a single cycle. As against this is post-neolithic technology for processing information which again has the characteristics of totality and randomness. This is a completely different world. I can, therefore, describe pulses, which we call technological advances, but none of which breaches the assumption of the original technology or way of organizing work.

I can now describe something which does. And I introduce one to a completely different world. It is from the neolithic age and was dug up in 1923. Unlike the artifacts of the period, the workmanship is excellent: thin walls which are supreme. Now in terms of the artifacts extant in the day it was found, you can't successfully date it. This may have been partly turned on a wheel. If it was, it would have been one of the very first objects of this sort. It was not built up of coils, shaped by hand and finished by scrapers the way pottery had been made just prior to this. There is some evidence it had been turned by a wheel in the shaping process, a very very early example. This process can be explained to the student. He can be told this is one of the early techniques and it is one of the basic ways in which man forms things. It has these characteristics.

Let him turn 1 or 2 things if he wants to; I don't care about that. I would, however, illustrate to him that this technology is challenged by injection, casting and a lot of other things. What I would do then, in this whole period, is make certain generalizations. These generalizations relate to different kinds of tools or machinery like the use of the wheel, the use of the crank, the use of the incline plane or the lever. These are the classic generalizations that man has made about how to shape and make things.

Then you show the limits of technology and how these have been reached. And so we have available to us things which aren't done this way at all. These we discontinue.

IKENBERRY: What you are really saying is that although Paul has moved to a second level of abstraction which appears to be much more stable than a purely skill oriented approach, even this second level of abstraction fluctuates itself. I mean it is violated--turning itself is violated.

MULLER-THYM: Yes, and what I'm talking about should be incorporated in Paul's general theoretical framework. It is only the content of these few variables in the center of the sphere that would be changing.

But the reason I gave is that if technology is an intellectual activity and it is a way in which man's intellect directs the forces of nature, the extension of himself through tools and things of this kind, then of course industrial arts has to have this element of intellectualization in it. In this framework, having a laboratory is perfectly fine with me.

I would then want to carry this out to the place where I would have a lab for the organization of productive processes, or the organization of a productive array. This is not the approach that I have here. But take a place like Appliance Park at Louisville. There is the General Electric Plant which really was one of the early achievements of the operations research boys. There the monorail is used for two things, one as portable storage. Secondly, it is the instrument through which one reorganizes a plant. On any given day you cannot tell how many plants are under roof--there may be 30, there may be only 1. But what you use the monorail for is dispatching. So the plant is organized by organizing space. The productive capability is the technology you're talking about. The whole problem of organizing a productive array today in many plants across the nation, whether it's transport systems or a single product factory, consists in the organization of the matrix.

I don't see any reason why you couldn't set up a laboratory with scale models of some really modern machine tools together with little computer programs and a console. If they want hands-on experience, here would be some hands-on experience of how you organize a productive array. This is a technology which is a kind of super technology. Whether you should do this in high school or not, I don't know.

DRAKE: You would be collapsing the three factors that Paul had into one, namely, the productive array. He divided it and then interrelated production, transportation, and communication.

BRENNAN: This laboratory is an all-purpose laboratory if you stay within the framework of Muller-Thym's organization. If you study them in this organizational framework, you only have to have one lab in order to experience all three.

DAWSON: You talked about collapsing Paul's arrangement. This is the only thing I saw in Paul's presentation last evening that concerns me. This is the transportation-communication-production approach. I'm not sure. It may be right and it may be wrong. I don't know. But this is the one part that disturbs me because if we say that is the content area, or the foundation of the content area, we are delimiting technology.

IKENBERRY: But perhaps, though, it really doesn't make a lot of difference. Man can be very ingenious in developing and organizing principles and categories but he can also be just as ingenious in tearing them down and building them up another way. Maybe what you're really saying is that you have one big body of information and you want to accomplish some kind of objectives through some kind of organization. I felt uncomfortable with it too but on the other hand, not because I disagreed with him but perhaps because I could see a half dozen other ways to split the pie, perhaps just as easily.

BRENNAN: Maybe the indication here now is that we ought to have just one.

DRAKE: Well if there was just one, I would ask for the industrial process.

MULLER-THYM: The first design criterion for the organization of any productive array comes from the marketing and not the production system of the business.

DRAKE: The only thing that bothers me about looking at it strictly from the industrial process viewpoint is that I don't know how to introduce the significant exceptions resulting in key innovations. Somebody like Edwin Land and the Polaroid camera. He didn't care whether or not it was marketable. He was interested in developing that technology. It turned out to have a fantastic market.

MULLER-THYM: He was pretty deeply involved in the company, in marketing the thing and so forth, wasn't he?

DRAKE: Yes, but another innovation which he values as highly as the camera is the Polaroid windshield and light system for automobiles and yet it was a "flop" in the market place. Maybe the study of people like Land, Edison, Bell and other innovators would indicate the exceptions to the perfectly rational process.

MULLER-THYM: Yes, I think this is true. In a course they would be concerned at one point with invention, the nature of this process, how it is organized and something of the history of inventors. This is different from the innovation one. For example, DuPont as a company, is pretty good on bringing things to the market place. Coca Cola is very strong in the skill of how to manage a distributor relationship, but they're not good on innovation. They have brought only one new product to the market place after Coke and that's Fresca.

DAWSON: Mr. Chairman, in 5 minutes we're going to call time on this part of the program so maybe you would want to summarize our discussion.

DRAKE: It seems to me that what we've done is take the ultimate in a non-directive approach. Probably it's the best mode of operation. We'll have a chance to pose some questions to Paul. On the other hand, an informal statement of objectives is something I think we owe him. I would hope that we could try to do this in our wrap-up.

Friday Morning
November 10, 1967
General Session
Dr. Kenneth Dawson, Chairman

DAWSON: This morning we will have 2 reports from the discussion groups. Discussion group number 1 will be first with Bruce Sinclair making the report, after which Bernie will make a report for group number 2. Before these reports are made, I want to give you an assignment. We're going to ask each one of the consultants to give us a brief statement following the reports on how important is the study of technology or the new industrial arts, as a part of the general education for boys and girls? And what should be the anticipated behavioral changes or outcomes? How is the individual who studies technology or industrial arts different from one who does not? Please keep the statements brief and to these points.

SINCLAIR: Neither my repertoire of skills nor the time allotted is sufficient for more than a suggestion of the concerns which motivated the discussions of Group Number 1. But by way of characterizing briefly the tone of our meeting, it would be fair to say it was general rather than specific; discursive rather than explicit; subjective rather than objective. Essentially, though not as opposed to existentially, we considered two primary conceptual issues. First, in what respects would a new program in industrial arts be distinguished from prior efforts? And second, what would be the basis for implementing such a program? As regards the first question, our consensus seemed to be that a new program might well be styled "Man and Technology," rather than industrial arts, as an indication of a substantially different orientation. The new description suggested to us enough of the past accomplishments of the field of industrial arts to satisfy the question, what could it contribute? But at the same time it denoted an awareness of future potential, sufficient to answer the question, what should the field contribute to the educational needs of the individual and society? We developed, in the nature of our first principle, a belief that the development of rational powers is the primary aim of education, accepting at the same time the difficulty of generally predicting individual needs. In fact, the diverse nature of society itself would seem to suggest an educational system which would be sufficiently flexible to allow for individual variation and need. Furthermore, we agreed that all individuals, regardless of social status, ethnic background, or powers of abstraction, can be benefitted by the study of industrial arts. We considered the educational process in terms of apparently different levels of public educability, and agreed that industrial arts education could be adjusted, with some degree of flexibility, to fit individual student needs, through structured content, ability groupings, or similar techniques. Time and again we returned to change and relevance as critical elements in a new program of industrial arts. To us, it seemed that Dr. McHale's work provides a reservoir for beginning the task of identifying the concepts involved in the study of man and technology. Generalization, in terms of concepts, further suggested to us that the work of Professor Haskell provides an important tool whereby this reservoir can be synthesized. Friday morning, this morning, we returned to a consideration of these same issues but directed more toward the needs and opportunities of industrial arts education in a democratic society, the emphasis in this case on the imperatives of that kind of a society. Our discussion touched upon the issue of leadership in an advanced society, and the function of the university, as well as industrial arts, in that society. An apparent knowledge gap--a situation where an increasingly smaller number of people makes decisions affecting an increasingly larger number of people--troubled us. A reflection of that concern was our discussion of how Dr. DeVore's program could be implemented. Our feeling was that a new industrial arts program, because of its relevance to contemporary problems, might well move to the center of the educational process. By itself, that suggests a fairly dramatic renovation of the traditional industrial arts program. Finally, we suggested the names of some possible resource personnel who might contribute to the implementation of that program. Among those names were the President of the New York Institute of Technology; Marv Feldman of the Ford Foundation, who has been concerned with relevance and vocational and educational emphasis; Harold Cassidy of Yale; Hunter Shirley, who is interested in systems of human behavior and learning; Edwin Layton of Case Institute, an historian of technology; someone who might connect government and education in his own experience, similarly someone from the field of engineering education; Athelsan Spilhaus and Stewart Bruchey, an economic historian.

DAWSON: Thank you very much, Bruce. Without comment at this time, let's hear Bernie Muller-Thym give a report from Group Number 2.

MULLER-THYM: In many ways a number of the issues that we discussed coincide with the ones that Bruce reports from his group. So when we come to those points, I will not spend much time on them. At the outset we were concerned yesterday with the points under subparagraph A, about the needs of the program. And among the needs that were discussed at greater length were: (1) giving the student a language which would enable him to move with ease in an industrial society where he is likely to find his place anyway, to have some appreciation for the modes of association and transactions among men, in such a society. (2) To give him a knowledge of how to relate himself with his environment when one of the big elements of that environment will be technology. I think we worked on the assumption, without questioning it, that in some way technology is our modern equivalent to what industrial arts may have been yesterday. What is his relationship to environment--not only to technology, its meanings, its processes, which concern the way in which men organize productive activities as well as the particular techniques by which they make things. Also the awareness, as one member of the group put it. People have not appreciated the delicate balance between society and its environment. The understanding of what this relationship may be would be one of the needs to be satisfied in some part by the program. In addition to this, the raising of certain fundamental questions about abundance, about the kind of abundance, about the meaning and uses of resources in the world. Of course technology and resources themselves have some kind of relationship. Then another factor discussed was introducing a student to concepts of change, not only the implications of changes induced by the impact of technology but the understanding of how the process occurs. For example, when there has been a real technological advance, we almost invariably in the course of history have looked at the new technology simply as a different way of doing what we have already been doing. We considered it as replacing the old instead of understanding the power or the genius which the new technology had in its own right. Understanding something of the management of change itself as a technology, whether this be social changes, political changes or bringing new products to market.

Looking at these needs it appears very strongly that some overriding purposes of the program, at the moment when Paul comes to form objectives, would be such things as life guidance and introducing the students to uncertainty; that uncertainty operates in the universe. Second point was this. The group raised the question: "What is the purpose or what is the reason for there being such a program in a curriculum at all?" This was the feeling shared by all. Apparently Paul and Tom have taken a strong position too, that what we're doing here is not vocationally oriented. It may help a person live better in a technologically dominated world but it's not oriented to any particular vocation. And the test of whether a program of this type might be valid would be whether there should be courses in industrial arts in a high school like New Trier. Would they have meaning for this kind of student as part of--for want of a better word--liberal education? And out of this developed the position that technology is an intellectual activity of man, as science is an intellectual activity of man. And therefore, either mode of treatment, either the history of technology or specific courses like those suggested by Paul last night, would aim at generalizations of some sort. If, for example, we take the methodology of turning, which is one of the technologies used in various ways with the wheel, the lathe, and so forth to produce objects, we would make generalizations about this over a period of time. What is the meaning of the new technologies which are emerging as against those which are being replaced? With the simple changes within the technologies of making things and organizing a productive array, a very large percentage of what was the subsitive content of industrial arts programs in the past will disappear and be replaced by something else. This ought to be reflected in course content, in the kinds of things we would have in the laboratories, hands-on experience, and so on.

Some comments about the courses. They ought to be open ended, capable of self revision, self renewal, self replacement. They should be aimed at all students regardless of sex. We still should not lose the magic of being in contact with the real world, that feeling of pleasure that dealing with tools gives one. This is a problem because the teachers apparently who tend to gravitate toward industrial arts and like to teach it are people who are hobbyists and like to make things. This is fine, but it also presents a limit on what they are likely to do or how far we may be able to bring them. If we should retain laboratories and workshops, these should contain not only tools--which would be the old familiar stone-age tools with electric motors on them that by and large still form about 90% of what you find in industrial establishments, but we should incorporate scaled-down versions of new kinds of machine tools which embody completely different design principles. We should be able to give the student some way of producing program tapes or sitting down at a console for experiences not only of working with new methodologies and making things but with the methodologies of organizing space and time and doing those things which are really at the center of the magic by which we make things today. We organize our productive arrays by approaching the management of space and time directly and the most central magic of all is we manage space by managing time. For example, the control tower for an airport manages space by managing time. There is a hierarchy in the acts of management that take place. These are at the center of technology today and were not in the past.

There was some discussion too about what a new name could be. The discussion was abandoned but it was interesting to note that words are very similar to those which Bruce reported. "Man and His Work" and "Man and Technology" were among the trial efforts which came up and had apparently been anticipated by Paul, Tom and Ken and others who had been working on this long before we convened yesterday.

There were some suggestions, finally, about courses and faculty. They went something like this. There surely ought to be one substantial course--either 1 or 2 terms--on the history of technology. This history ought to be loaded with examples and of the kind Paul described last night as having been offered as suggestions by the patent office and so on. What are the really important things that have happened? It would be the history of inventions, the history of inventors, the history of the pulses of technological advance, and the history of the changes of principles; the organizing principles by which a man thinks.

It might also include, for example, a course in systems in which one would possibly start with the kinds of generalizations about systems and their laws that Ed used as the fabric of his presentation last night. It would be best presented as a like natural history. Here is this kind of system, here is that kind of system, and here is this; some of which involve humans, some of which do not. You might take for example, a meteorological sattelite as a system. You might take a city as a system and so on. And within these you begin to develop the terms of the dynamics of the interactions of the parameters, the way in which one has to understand design as being different from the things that are not systems, that are atoms or things of this sort. From this, one would begin to make the generalizations which would either be the same or contiguous with the generalizations that Ed has made.

There would be another. This pertains to change. One would describe again a sort of natural history or various instances of change and show what happens when change occurs, describe the different methodologies for bringing about change, whether this be in political action or in the introduction of a new product, to a consumer market in an industrial society and with the change agents, or methodologies available, for including something of this sort. These are just 3 "for instance" type courses. Interestingly enough, none of these was defined by the subject matter such as communication, transportation, and so forth. Although there was some feeling that one might be able to constantly adopt some kind of systems approach to the organization of the productive process as such, and be able to deal with these things simultaneously, even still, concretely, but we didn't get very far with this.

Finally, we ask, "Where are we going to get the faculty for this program?" The proposal came up that first of all, if we consider the modes of learning congenial to people living in an electronic world and if we consider the resources available, we would propose this solution. For a certain number of courses in the program the university would have a small, but very able, core faculty. Then some part of the budget would be set aside for specialized faculty. This isn't just a matter of a person coming here for a sabbatical. But this would be a possibility too. Rather we were interested in the modes we are using here at this conference, those which are congenial to adult types of learning. Instead of having a course in a field of knowledge, where one proceeds linearly to develop material in it we would have massive inputs for brief but intense and significant periods of time. There would be 2 or 3 days structured around organizing ideas. These would be discussed in some depth although there would actually be discontinuity. You would leave it to the intelligence of the students to fill the tissue in between. While they might not all fill them in the same way, about 90% of what they would do would all be useful and to the point anyway. We would set up for a given year with 8 or 10 resource people. One of these might come at specified intervals of a month, for a 1½ to 3 day period. During this time the students wouldn't be responsible for anything else. They would participate morning and afternoon. They would work with this person continually. He would return a month hence and develop the theme further. In between the students would be reading, studying and working at some of the more continuously organized courses of instruction. With this combination of core faculty and the use of this special resource person, it would be possible at West Virginia University to attain the results desired. However, if you went national on this you'd have a hard time spreading your resources. But that isn't really your problem. There is a distinct possibility of being able to mount the kind of effort we have in mind. This, in substance, is what we talked about.

DAWSON: Thank you very much, Bernie. Rather than reacting to these reports at this time let us hear your statements concerning the conference as it has been up to this point. If you want to make a comment as you go along concerning these progress reports, fine, but we'd like you to make a statement just as you feel--if you believe a topic should be omitted, fine; if you feel it should go in a certain direction, let us know. David Allison, would you please begin?

ALLISON: Then you don't want the answers to the 2 questions at this point. Is that correct?

DAWSON: Not necessarily.

ALLISON: To the first question: how important is the study of technology as part of general education? I would say this. Most of us will agree that we live in an age of technology. I've thought a good deal about that phrase and what it means. I recall driving down the highway to the New Jersey seashore. Over on the hillside, half a mile from the highway, one sees a large building. It is difficult to see from the road, but when you get close to it, you find it to be a large glass laboratory. And within the building are more engineers and scientists than existed in all the world in the days of Galileo and Shakespeare. Well, this simple example suggests to me that this world we've talked about for the last 2 days--this world of science and engineering--is simply too important to the people of the world today to ignore. And, therefore, I think it important, in terms of the development of an educated human being, that he know what the technical world is about, and what the people who make that world are like. Another way of measuring this is in terms of the federal budget of the United States. About one-half of the "flexible" part of the U. S. budget--that is, the money that can be shifted from year to year, from project to project and department to department--about half of that flexible budget is technology-oriented or science-oriented, which means that before the money is spent somebody--a non-scientist, or non-engineer, or even a Congressman--somebody has to consult technical people on the allocation of these dollars. The more informed that non-scientist is, the more informed he is on science and technology, the more intelligent will be his decision on how the funds are allocated. These two examples, the number of people and the number of dollars, suggests that the study of technology is a very important part of one's general education.

As to the second question, about the kind of person who studies industrial arts and how he might be different from one who hasn't, I will answer that that person should be "comfortable" in this world of science and engineering. What do I mean by that? I remember a charming scene a couple of years ago. I was on a plane from Boston to New York. It was the beginning of spring vacation. I was in the back of the plane with 3 or 4 kids from MIT; the oldest of these was a girl who, I gathered, was a sophomore. She was talking with 2 young fellows who appeared to be freshmen. They were asking here--preparing themselves, I suppose, for the second year--about the computer program that she had been studying through the sophomore year. She impressed me with the facility with which she was able to discuss the various merits and demerits of Fortran and whatever other computer language she had been exposed to during that year. And as she talked so knowledgeably about the computer, she was doing needlepoint. I liked the scene because she seemed to me to suggest the kind of person we ought to be producing--a person who can exist in several worlds comfortably at the same time. Those are my answers to the 2 questions. I would like to say one other thing about the moratorium. I think all of us will agree it has been a good idea for the university to take this period to think about what it's been doing. And again, I have a story here to confirm my belief. It comes from one of the greatest industrial artists of our age: Theodore Von Karmen. The story has to do with

Von Karmen's days as Chief Science Adviser to the Air Force. Someone asked him about crash programs, apparently the military was attempting to get Von Karmen and his people involved in a crash program for the Air Force. Von Karmen described a crash program as follows: He said instead of getting one girl pregnant for a 9-month period, you get 9 girls pregnant in 1 month.

DAWSON: Thank you, David. All right. Edward Haskell, would you please give us your succinct and brief statement on your feelings concerning the conference?

HASKELL: Yes, I'd be very glad to. The kind of thing I would like to say is this. The structure that we need is a cybernetic structure. It has to be a self-building, self-developing organization which constantly receives feedback from the students and from their families back home. It must minister to their felt needs. It seems to me that to get this, one has to do what Wiesner said in his televised discussion with C. P. Snow: The kind of thing we need has got to happen all at once. The present trends are strong and piecemeal things tend to get changed back. The kind of structure that is being discussed, the cybernetic kind, simply has got to start all at once.

DAWSON: Thank you very much, Ed. Now Bruce Sinclair, would you care to add to what you said before the group a while ago?

SINCLAIR: All right, thank you. As regards question number 1, "How important is the study of technology?" I take Fidel Castro as my model and say: "Technology, Si, industrial arts, no." I appreciate the point that Bernie has made and that Mr. Haskell has also made in our group that there is some real value to an appreciation of things and of working things and developing manual skills. I am reminded, however, that this is a view which was originally propounded in the 19th century by people like Ruskin and others. The view fitted a time in which alienation in an industrial society was significantly the real problem, and there was some attempt to re-introduce crafts, hand techniques, and an appreciation of what craftsmanship meant. I'm not sure that view is relevant any more, aside from what personal satisfaction it gives to people. I think I could not better enlarge upon the current importance of the study of technology than Dave has already done. I'm impressed with its importance as an area of study in accredited institutions, and I take technology to mean past, present, and future. In this sense, technology, however discontinuous it may be in its own development, is continuous in its relationship to man. Man is the essential ingredient and people continue to react in certain kinds of ways which are historically valid.

As regards question number 2, "What might we anticipate on the part of students in the study of technology?" The thing that concerns me most is simply that we provide them with an awareness of contemporary problems, those issues which are real problems today, and give them some concept of the mechanisms which might be employed to solve those problems. Implicit in that point of view is an awareness of the future. In this sense, I may well be distorted by my own experiences at Kansas State University. One of the things which impresses me most is that the vast majority of the students are totally unaware of the present and thus unaware of the future. And I suspect, as a matter of fact, that the students at Kansas State University are typical of American students rather than atypical. The students at Berkeley and Wisconsin may be atypical. We might be concerned more with the kinds of students that are at Kansas State University and at similar state universities throughout the country. These people are unaware of today's problems. They are unaware of the technology of today and are therefore unaware of the problems that technology presents for the future. I am impressed by a remark Bernie made, that technology, in his broad definition of technology, may very well do for today and the future what industrial arts, in the conventional sense of that term, did for the 19th century. I think that's a possibility. If we continue to turn out in industrial arts courses nothing more than badly-made junior high school bookshelves as the only really significant act of that program, then it seems to me we have betrayed the opportunity which technology presents to us.

DAWSON: Thank you very much, Bruce. Stan Ikenberry, we're going to skip you and give you the last word-- so Bernie Muller-Thym, would you want to add to what you said a while ago?

MULLER-THYM: I could pass, really, without doing any damage to the conference so I'll just try to say a few words in affirmation. I did not really become aware of technology, or the relationship between man and tools and so forth, until I was well along in graduate studies in philosophy. One of the things that Aristotle does when he is discussing "what are the ultimate modes of being and of predication," is to go down a list of ten. We translate these into English as nouns--like substance, quantity and quality. For Aristotle they are questions. What is that is that is, when you say is. And the tenth and very last one of these we translate into English as habit. It's habit in the sense of a riding habit, or a nun's habit, and not the way of doing something. And what Aristotle is asking, "How does a thing hold itself a special way?", he is talking about how man who is born naked nevertheless is potentially all things, becomes all things through the activities of knowledge, of love, of cognition, and becomes all things in the world by building for himself artifacts. This is really the central theme of McLuhan's book on Understanding Media. And I think that in our discussions here, in our thoughts, we ought to go back and really re-reflect on what McLuhan has said in his book in light of our discussion here. I recall a couple of years ago when Donald Shone read the book for the first time, he was enchanted. His first comment to me was, "For the first time in my life, I understand what technology is." This was when he was Director of the Institute for Applied Technology in the Bureau of Standards. Because if one, for example, says that clothing is an added extension of skin, that house is an added extension of both of these, and that house is not simply something to protect us from the rest of the world, but it gives a certain kind of capability of living, of creating the alternating rhythms of privacy and community, of being kind of membrane that regulates ingress and egress, so that we can shut out things at will or we can pass things at will, which itself would have sensors buried in it so it would be a kind of communication system as well as providing him with living tools for doing things he does when he is leaving the semi-private part of his life. Then what house would be, if we understood it in this way, would be radically different from the primitive extensions of cave, and early lean-tos, and frame dwellings which we generally throw up in our communities. In the same way you would understand the city as a political environment which is so designed that it would enhance the transactions among men, which is what a city is for. This is all part of what Aristotle was talking about. And in this same period

I became also very much aware of this also in the things that Harry Gill was writing about tools and machines. I don't know of anyone who has written more intelligently and more pertinently about it. It was characteristic of our society that no one even knows what he did, much less has read it.

Well, in a world where I am in favor of as general, and as non-purposeful and as intelligent and intense an education as possible, I believe anyone can pick up the techniques of learning "how to do" things someplace else.

One of the things that came up in our discussion was that if you're really going to talk about technology in the context that Paul and Tom and all the rest of us have been talking about it, presupposes a change in the entire educational system. In essence, the thing which we are talking about for a curriculum in industrial arts or in the technology of man, would be one that would have to affect the rest of the educational system. It would affect it horizontally. There would have to be changes in other curricula being taught at the various levels to attain the necessary interaction between technology and what is going on in the rest of the high school. In the same way we have supposed that vertically there would be the same kinds of interactions. For example, if it is valid to teach physics in high school and again in college and also in graduate school, it would be meaningful and valid to teach technology in high school and again in college, and again in graduate school. This is true because we are supposing that we are dealing with one of the basic connections of man. In the same way that science is an intellectual activity, it's basic, it may change, the way it does things, its content, and so forth, but as an activity it has a character and continues in the same way that logic has this character. In the same way that the study of conduct and the structure of the moral order has its character, so technology has its character. It's one of the handful of basic things that one can identify. So, presented in this context, I don't see that we have any need to validate it at all. It would be impossible to invalidate it. It stands in its own right; it's conspicuous; it doesn't need help from anybody else. And if we can listen to it speak to us, we will get more of an answer than if we try to speak to it or pose a kind of pseudo order not appropriate to it.

DAWSON: Thank you very much, Bernie. Bill Drake, we'd like to hear from you now.

DRAKE: It seems to me that for "new industrial arts" an important concept central to the curriculum is the consistency of change in our world. The rate is increasing--technologically, culturally, by every measure that one can use. It poses very difficult stresses on people; it's making it more difficult to relate to their environment over time. The entire educational system has been attempting to react and/or adjust to it. Consideration at the lower levels of education of the more basic elements--the new math, emphasis on basic science as opposed to applied, are attempts to equip for a radically changing world. Greater concern about emotional stability and social adaptability at the early school ages is another area. It seems to me that one way industrial arts can relate to this problem is by focusing on equipping students to understand the forces that are causing change. In this case industry must be broadly defined to include areas such as health-related industries, transportation and communication. The other point has to do with evaluation. Let's assume that a rather large scale revision is undertaken and that it's "successful." Why is it successful? How do we know it is successful? In the field of education over the years there has not been developed adequate measures of success or failure. Whatever is done must build in, from the beginning, the ability to evaluate. This has certain implications. It has implications that indicate a long term process and experiment. It's not something that you're going to be able to evaluate in a year or two or three. It's the type of experiment which will have to be undertaken over a very long period of time. Frankly, I don't even know how you'd go about doing it right now. That is, I haven't thought about the right measures of performance. For instance, what does it mean when I hear a statistic like, "There are 25 graduates of industrial arts in West Virginia University each year"? Over a 5-year period, that's 125 graduates and out of that group only one becomes employed in the state of West Virginia. This situation poses a monitoring problem, when trying to evaluate the results of program changes compared with previous alternatives. I'm still concerned about explicitly formulating goals and objectives, however, there have been a series of *implied* goals and objectives. I'd like to see if we might discuss this further.

DAWSON: I assume you are thinking of educational goals. Last night I stated that I thought that goals would be inappropriate for discussion at that time. I still believe that we have implied goals for the last 2 days. We have spelled some of them out and with some ramifications. If the goal is to teach about technology or about technological literacy, our goal is to help people become livable within a society largely based on technical principles. I don't want to get involved in this discussion myself. I have tried to stay out of the discussions as much as I could because of my past experience in industrial arts. Why don't you expand on your idea on goals and what you'd like to see? Maybe you can raise a specific question for our consideration.

DRAKE: I'm not sure I can.

ALLISON: As Senator Randolph said, "I've only got 5 minutes, what are you fellows up to down there in Morgantown?"--maybe that's the approach.

DE VORE: I can try to reply to this in a brief statement. Those of us in education recognize that one of our prime functions is to prepare individuals to live in a given culture. Some people say it's transmitting a way of life and getting people ready to assume adulthood. The reason for the present project, and the reason for my concern and others within the profession, is the realization that you cannot use the kinds of programs that were developed in the 1800's and the early 1900's, which have been mentioned and alluded to here, for today and tomorrow's students who will live in the 21st century. We have a whole new creation by man intellectually, and one of the most prominent forces which Bill Drake has mentioned is the one of constant change, technological change. At no place that I can find, at any level in public or private education, is any area of education dealing with this. However, the area of education that maintains its foundation in this area or has relevance in terms of content here, has been industrial arts. The field of industrial arts has some very fine objectives which were stated in the Washington Conference of 1960 and other conferences such as this.

But if you examine the programs which are in the schools in Kingwood, West Virginia, or over in Bellaire, Ohio, or Cleveland, Ohio, or New York City or anywhere, you find the crafts of industry being taught. The emphasis is on the manipulation of tools and materials. Yet we have all admitted in this conference that this is not what technology is. This is not what is happening.

Our conclusion, then, in the approach to the problem here in West Virginia, was if we were going to do something we should not approach the problem from the retraining end. A whole new program is required to prepare a new kind of teacher for the new age.

As I reflect on what Bruce Sinclair has said when he raised the question: What kind of culture? What kind of society? It is a democratic society and it has a major force within it called technology. So if we are going to have citizens making decisions, which Dave Allison discussed previously, intelligent decisions in a society, then our citizens must understand technology.

In addition, it's a human problem for me and others who are studying the problem. For this reason we reject narrow specializations and skill training because if we narrow it down to narrow specialities and don't really get to the essence of the generalizations that Dr. Muller-Thym discussed and what I call the phenomena of technology, then it is education for slavery and a restriction of the possibilities for the human being and his development. This is the briefest way I can put it, on a philosophical basis, without getting down to specific behavior terms. We can, I believe, outline some of the kinds of behavior we would expect to be evidenced in performance terms.

Finally, I don't reject the need for a statement of objectives or an operational definition so long as they are accepted as tentative.

IKENBERRY: I'd like to speak at this point, Mr. Chairman. The summary remarks I was going to make were really pointed at these issues and it may be more appropriate to make them now than to wait until later. In my own mind the problem is bound up with the question of purpose. One really must ask what the function of education is in our society and work your way down, if the transition is possible.

Many times, I think Paul is quite right. These statements are so nebulous and so hard to get hold of that they turn out to be meaningless. But I would suggest that perhaps we might summarize the total function of education in three original objectives. (1) It should create, expand, and sustain throughout life the freedom and flexibility of occupational choice, development of life style. The purpose of education is to make this an increasingly broader range of choices rather than to limit the range of choices a person has. (2) It should equip a person to be able to function effectively and functionally in a democratic society. (3) Education ought to provide the means for the preservation and advancement of the culture so we don't have the lapses we were talking about last night.

I don't know if this list is right or not. But let's suppose for a moment that these 3 functions are reasonably appropriate. I think most people are beginning to feel, along with Ed Haskell, that our society is in trouble and we are running the risk of increasing social disintegration. This is evidenced most clearly of course in the urban areas but I would submit that the same kind of deteriorating processes are going on in these hills except they manifest themselves in ways that aren't as offensive, or visible, to society. And I think the problem of social disintegration is related in part to a failure of the school to achieve these 3 objectives that I talked about earlier. One was to sustain and advance the flexibility of occupational choice. Some of you, for example, described it as the knowledge gap, that gap between the man on the street and the critical decisions that are being made that influence our society. This seems to be widening all the time. How do you narrow this gap? Somebody else described the issue of the delicate balance between society and the environment. That is another way, I suppose, to describe the problem.

Now as I read the section on objectives of industrial arts in the publication, "Improving Industrial Arts Teaching," published in 1960, I see a discipline or a program that knows it is in serious trouble. It is very unsure about its role in the schools today. And I think the crisis is primarily the crisis of objectives. The earlier objectives that gave meaning to industrial arts many years ago--a century ago--simply are no longer very relevant to the kinds of problems that face youngsters today. In another publication, the 1967 Proceedings of the AIAA National Convention, a speaker says that "What you or

I think of industrial arts does not justify its inclusion in the curriculum. It's got to be much more functional than that. It's got to begin to get at some of the more pressing problems. Right now I think it runs a very clear risk of irrelevance or if not irrelevance, at least very little priority on the pecking list. And I think college and university training programs help perpetuate this irrelevance. This is basically the reason why we tried to call a moratorium. We hope, you see, to break this cycle.

Now to come back to the point you were raising. What are the objectives? I could tell you, Bill, that this is the point of crisis of industrial arts. Is it to maximize the range of occupational alternatives, by exploring the world of industry and understanding some of its complexities and so forth? I thought your point in terms of the ability to adapt to societal change, when so much of this change is being brought about by industry, was relevant. If one doesn't understand the forces and the complexity of the industrial society, it is very easy, I would suspect, to become baffled by the change process in which one finds himself. To provide an integration between the two cultures is important no matter what the student intends to do in later life. Our projection is that he is going to live in an industrial or cybernetic society. I guess I don't know what these objectives are but I think objectives are at the root of the crisis, you see. I wanted to reinforce what you were saying and suggest that we take a look at objectives and the translation of them into behavioral terms.

DE VORE: Let me refer to one of the diagrams we discussed last night. It was adapted from Cassidy. When we move to defining objectives in behavioral terms, you move to defining functions and activities. What does a person do? This includes not only knowing but the processes of the discipline. This is the way Cassidy has approached his study of the different sciences and disciplines within a university. What are the activities of the practitioner, the chemist? What does he do? There are behaviors he evidences--such as ways of thinking, doing, knowing, analyzing data, collecting data, and so on. He knows how his discipline accumulates knowledge. He knows how his discipline changes. If we can come to grips with this, rather than broad objectives such as understanding industry, we may be able to progress. These are very vague, you see, because they say nothing about what the person will do. So you cannot measure it and you cannot accomplish it. You can only say, "This is nice to have." It's a very general term.

IKENBERRY: I'd like to make one other point with reference to objectives. As I read some of the objectives I'm not sure that there isn't some incompatibility among them. For example, I have a notion that there may be some incompatibility on the one hand with the objectives, "to develop in each student an insight, an understanding of industry and its place in our culture" and "to develop in each student a skill in the use of the common tools and machines." These may or may not be compatible. I don't know. I'm a little fearful that the second objective has a tendency to cannibalize the first one in practice.

DE VORE: This is true, and this is precisely what Marshall Schmitt's study shows. It is the same thing that Collins' study for the Appalachian region shows. The objective on skills predominates and three courses are the predominate courses of our industrial arts in the field. They are: woodworking, metal working, and drawing. These areas certainly do not lend themselves to accomplishing any of the objectives implied by this group in the last day or so. They are not relevant to your discussion or concerns.

HASKELL: Might I make a statement? It seems to me that the objective is exemplified very simply in the way in which plants, say, evolve. For example, a moss. It clings on a rock or some such place and changes its habitat. This changed habitat either is going to kill the organism--destroy it--or that organism is going to appear which can live in the new kind of habitat. We have now changed our habitat, and our objective has to be, as I see it, to so organize our minds and our universities and our schools and our country as to be able to live comfortably in this new habitat like the young girl in the plane, who was discussing computers and doing needlepoint at the same time. This, to my mind, is the objective.

DE VORE: It has been said that what you do not understand, you fear or reject. This is what is happening throughout much of our society today.

ALLISON: In our group, one of the things that came up was the matter of choices, the hope that a youngster in the kind of program Paul is creating will learn that he has a wider field from which to choose than he might otherwise have known about. But from there let me go to another paragraph with the word choices in it and also with the word aesthetics in it. A youngster in Paul's industrial arts program is going to learn and is thereafter going to teach younger children that technology has great power; that indeed man has great power to do anything he wishes to do with his available technology. In other words, he will learn that he has unlimited choices at his disposal. Certainly this is true. But it is also true that with these choices and with this unlimited power, he also has the ability to create ugliness. The best example of this I can think of, although there are as many examples of it as there are cities in our country, is the city of Los Angeles, where you find that technology is capable of creating any neon sign in any shape or color; it's capable of plowing a road through any landscape that it cares to plow through. It is important, therefore, to introduce the value of beauty as well as the value of technology to a youngster at the earliest age.

DAWSON: Our time is just about spent. Does anyone want to make a further comment here? If not, it becomes my responsibility to attempt to summarize the conference. Each of you has summarized the conference yourself within the last hour. I would like to make a few points, however, which may help in consolidating our ideas. I believe the group would express to West Virginia University and to Dean Ikenberry, Dr. Brennan and Dr. DeVore, our sincere congratulations for calling a moratorium. I am sure it took great courage and people like Paul DeVore who came into a situation not even knowing if it would be alive 2 years hence. It took great courage but I think it took even more intelligence to do so. It seems to me that if 95% of the industrial arts programs across the country would take similar action, we might come up with something that would make a contribution to learning and education. If not, how much can the University of West Virginia do? This may well be the birth of a new type of program in schools throughout the nation or even throughout the world. I believe we would say to this university that we believe this should not be the ending, but only the beginning of a new program, that this is not the deathnell but the birth of a new program in technology. Industrial arts as we have known it in the past must not remain. There seems to be a need for a new program to replace most of the activities which are now known as industrial arts. It seems that technology could well be its foundation; maybe industrial technology should be its base. Technology is considered as an intellectual activity and not simply a study of the making of things or the using of things. Industrial arts should be an intellectual approach to technology as a characteristic of a democratic industrial and technological society.

It seems that a program involving man and technology could well be a core of studies especially at the junior and senior high school levels. Technology, being so very important to all lives, affects all our areas of life; the physical, mental, social, emotional and spiritual. Technology is continually spawned, produced and grows with interrelationships in science, mathematics, human resources and the other areas which make up education. I believe this group would agree that the type of program we envision should be for all boys and girls--not just for boys as has been the case of industrial arts for the past 60 years. This new industrial arts should be for all people regardless of their occupational or vocational goals and for all people, regardless of their inate ability. All of us who have any type of reasoning power will be affected by and will use technology and consume it, or it will consume us. The content for this course should be broad. We have mentioned several areas. Technological literacy seems to be a key point of our considerations relating technology and the environment to the individual. And the great abundance of resources that are produced through technology need to be known, to be able to consume and use them properly. The concept of change should be a vital part of the content of the new program, not only to effect the concept of change but actually to effect innovations in the area of technology. People should learn to reason, to increase, and improve technology as a part of the educational process. We have talked about the markets for technological output as being important to the young mind, and life guidance which provides direction for people. Industrial arts should help people get involved with this technical society, and to comprehend the areas of life which impinge upon technology. We've talked about such topics as cybernetic structures and feedback processes not only of machines and mechanisms but of young minds. Industrial arts should produce experienced and advanced minds in the educational process.

Several times this group stated, in no uncertain terms, and unequivocally, that this is not a vocationally oriented program. It is general education oriented, valuable for all people. The next point I would make is that the study of technology should be through generalizations and not through the making of things as it has been in past industrial arts programs. We talked about a name. We did not come up with a name that any of us would accept. One group suggested "Man and Technology." Both groups considered that name, but we reached no consensus. "Technology and Man" was also considered. We did agree the name for a new program should have the concept of man and technology. Whatever term West Virginia University may develop remains to be seen.

There is one problem which we have mentioned and I think one we did not mention. We said that the main problem for such a program if it should be implemented at West Virginia University would be staff, resource people who could put the program into operation. Another problem would be to get it extended beyond the very borders of the campus. Probably the most difficult problem will be to get it adopted in all regions throughout the country. This is a problem of great concern and one with which I wrestled for some 6 years prior to the job in which I now find myself. How do you get people to understand who seem to be so blinded, that you cannot continue to teach outdated crafts and skills, and even principles and concepts which lead to oblivion, or to a dead end? How do you get the 40 thousand teachers or even 5 thousand of these people to accept the fact that they probably are on a dead end street? How are you going to get them to accept something that is as vital as we find it to be? This is a tremendous problem.

We discussed some courses in addition to the content area. The courses should be open ended. Many of them today are not. All courses should be open ended and self regenerating or self-renewing, because technology is continually renewing itself. We are told that the amount of knowledge available to the human mind is doubling about every decade. Educationally, we must be self-revitalizing. We must be helping people understand how to learn, not only in the classroom but how to continue this learning process and to differentiate between that which is important to the self and that which is unimportant to the self. We talked about the courses as they should be maintained or replaced. We should not get away from the laboratory; the laboratory may well be the crux of the whole program, for exploration, for handling the objects or the items of technology, and to be able to manipulate, create, design and construct. We need a laboratory where we can do research and have creative experiences with the products of technology. Indeed if we ever get away from a place where students can have activity with these processes, materials and tools, we are short-changing our society. One of the conferees said in one of the small group sections, "Forbid that we ever get away from the idea that children can learn the processes of leverage, drilling, boring, and things of this nature, for we need this understanding. Whether you're going to be a doctor, a lawyer, or whether you're going to be a mechanic or a banker you need a working knowledge of technology. There seemed to be a hierarchy or order in which we could develop the courses or the content. The program should be thought of in terms of sequences, and techniques and programs that fit growing minds. The courses should include such things as a history of technology, principles, concepts and systems. It seems to me that systems and theories should go together.

We need a core faculty on this campus of great minds to carry out the things we have been talking about. We also need a good group of research people. Consultants should come in to evaluate these ideas continually.

We have agreed that Paul DeVore and Tom Brennan have already put together a tremendous beginning and we would congratulate these people on the start they have made. I have known these people many years and we have talked about the ideas and they sounded tremendous to me and they sound even greater to me at this point. We agree that the information which Paul presented last evening could well be that which will provide the very foundation for this program in the future. No doubt he will find some changes that will need to be made; no doubt we could, if we continued to look at it closely, make further recommendations. I would make one suggestion, on behalf of the group. You should recognize that you have brought together a group of consultants who are a peculiar lot. They are also probably very prejudicial in their approach to technology. I think we would all encourage you to take a look at what we have said, recognizing our peculiar natures, or prejudicial viewpoints, because we see things probably very closely akin to the way you have presented them.

The public does not. And it is the public's children that we will have to educate.

Now let us summarize the 2 questions upon which I asked each member to comment. How important is the study of technology as a part of general education? I believe we would say in mass, that it is very important, exceedingly important. Young minds need to be able to understand technology to live without fear and to have a good life in the future.

What are the behavioral changes we should expect from the new technology program? Mr. Allison mentioned the importance of being comfortable with the technical environment. Today we have great masses of people who are not comfortable with the technical environment. The mention of a computer to them is like mentioning research to an educator. He doesn't want to talk about it because he doesn't understand its values and limitations. Students need to understand that technology helps us solve problems but that it also creates other problems which may be of equal importance.

I would make one final comment. It seems to me that industrial arts cannot continue to exist for very long as we now know it. I said this in my original charge I made night before last. The type of program we have now is too narrow and too limited to command attention for very long. We simply will not have time in the educational program in the future to be involved with this type of activity. But I think that if we can replace industrial arts as we know it today with a significant study of industrial technology, then we could well have a core which will cause America to remain a great industrial power, not only technically, but socially and humanely as well.

I'm sure I have left out many things that you would want to have said in summary and maybe threw in some that you would not. Does anyone want to add to this summary?

MULLER-THYM: Great men are ones who know when to stop.

DAWSON: Although time is up, I want to ask Paul DeVore if he would like to make any comments before we adjourn.

DE VORE: Of course I can't pass up an opportunity to express our appreciation to this group. I have been more than pleased, and those of us associated with West Virginia University have been more than pleased with the interest and insights you have given to us during these last few days. I know that one other factor has been recognized. As we entered into this kind of endeavor it was perhaps one of the few times industrial arts really laid itself open to examination by a group of outside experts from various discipline fields. It is time we recognize that this is a needed and rewarding approach.

As we looked at the group we invited we were concerned as to how well they would function together. It has functioned very well and it is a rare experience to experience this kind of interaction.

I have a fear as we go down this line. It relates to a simple question. Can it be done? Can we meet this challenbe? We are human and we are limited in energy and intellect. The approach we are using will have to expand and continue to use your resources which are extensive as has been displayed here in the last day and a half. We will need people like yourselves who can aid us in making value judgments and to direct the change.

The crucial element I keep coming back to is training versus retraining. We have decided the retraining route is futile. We will be developing a new kind of teacher, to deal with a new type of education, in a new society.

I appreciate your critical analysis, your judgments that have been given to us, and your ideas that you have shared with us. Thank you very very much.

DAWSON: Thank you, Paul. Dean Ikenberry, we have reserved the final spot for you if you want to add anything to what you said a moment ago.

IKENBERRY: I have nothing really to add, Ken, except to say thank you for the time and energy that you've spent here in the last 2 or 3 days. The discussion I've heard has really been delightful and exhilarating. We were commenting last evening about the way the group seems to compliment each of the individuals. I hope, really, that everybody leaves here today more disturbed and with a greater lack of certainty than when you came in. Certainly I hope this is true of Tom and Paul. I suspect it is out of these dissatisfactions and tensions that something will come about. The lack of any real security at this point, Paul, doesn't really bother me. It's comforting. I too am overwhelmed by the size of the task. And one of the skills, I guess, will be to try to design the task in such a way that it turns out to be manageable. Advisably we can mobilize to accomplish it.

There is also the very practical problem of obtaining the necessary support to get this thing underway. And I refer not only to what I suspect will be the fantastic financial support that will be necessary for the effort but also the human resource support that is going to be necessary, as well as the institutional, bureaucratic kind of support that will be necessary. Increasingly, if we're going to get over the first hump, our attention must be devoted to three kinds of support systems, the financial, human and institutional.

I appreciate your affirmation of confidence in our calling a moratorium.

DAWSON: Thank you, Stan. Stan asked the night before last, when we first arrived, "How are you going to coordinate and chair a group like this?" We didn't have to do much coordinating because you were ready to go to work and you did. It's been a real pleasure and honor for me to have been with you as your chairman. I leave you with one story. The great French acrobat, Blonden, about 108 years ago, announced he was going to cross Niagara Falls on a tight wire. He announced his plan far enough in advance to draw a crowd of over a million people including the president of the United States, the Prince of Wales and other world leaders. To make the feat more interesting, he said, "I'm going to walk across the cataract with someone on my shoulders." They got about a third of the way across and the fellow on Blonden's shoulders started to make his request to turn back. He begged and pleaded and pleaded and begged but Blonden wouldn't turn back. All of a sudden, Blonden, in his French anger, said, and I would paraphrase, "Sir, just because you're on top doesn't mean you know where you're going." I'm sure we don't know where Paul and Tom are going by any means, but we will watch them go across and assume that they are going to get there and offer our wholehearted support in any way we can. Conference is adjourned.

Au revoir